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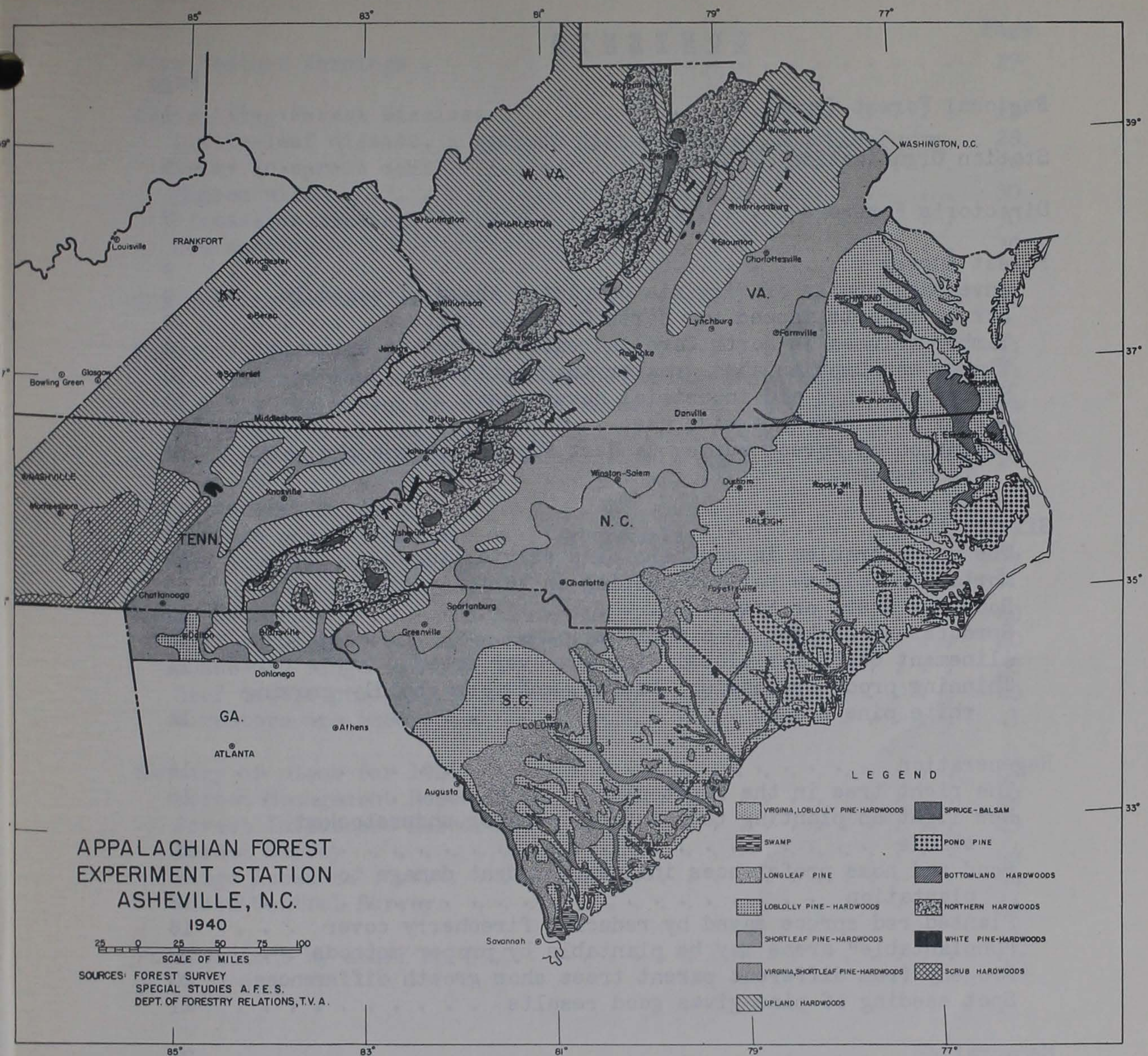
REPORT FOR 1940 APPALACHIAN FOREST EXPERIMENT STATION



U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

REPORT FOR 1940
APPALACHIAN FOREST EXPERIMENT STATION

JANUARY 1, 1941
ASHEVILLE, NORTH CAROLINA



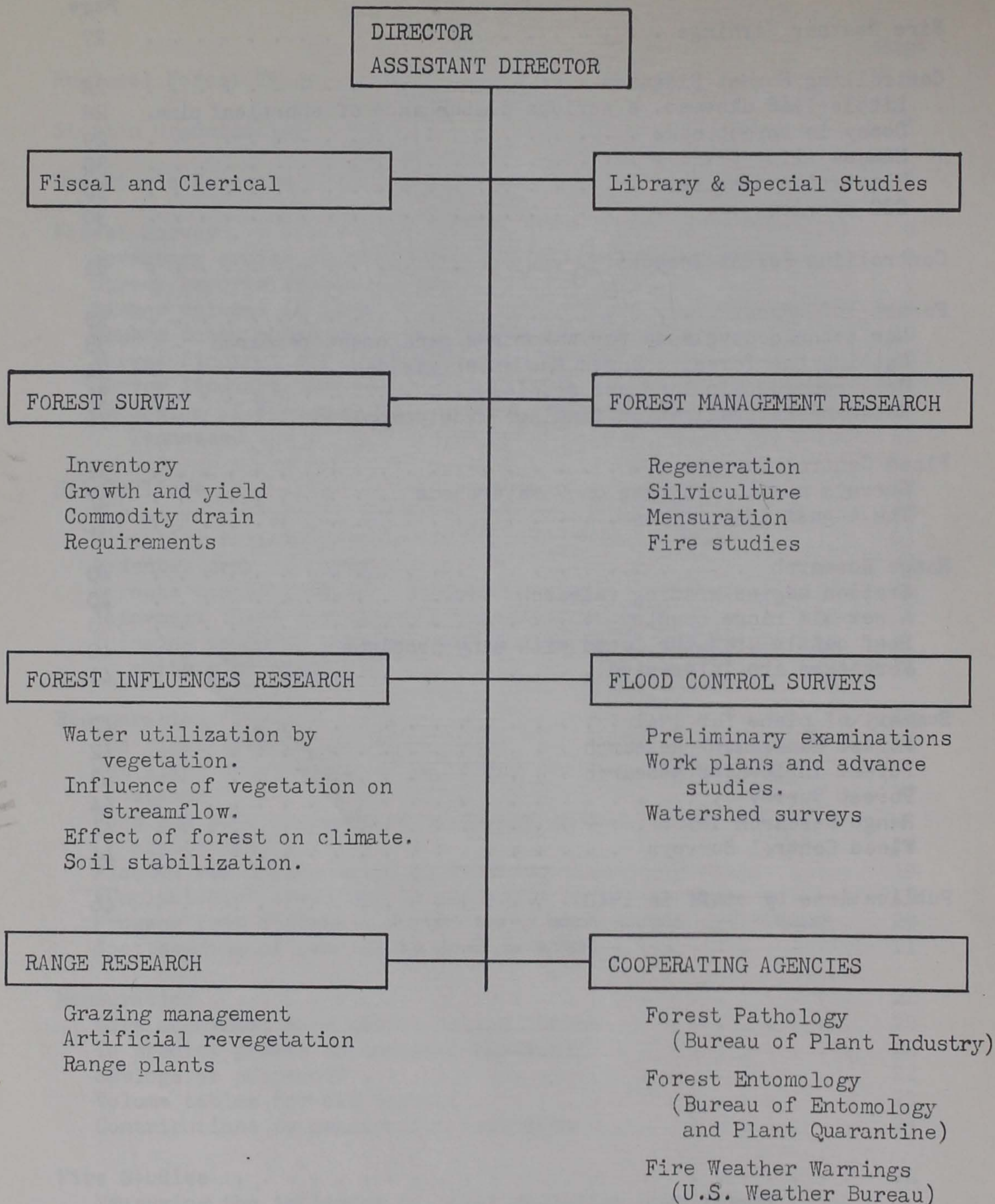
REGIONAL FOREST TYPES

The 12 regional forest types indicated on this map scarcely begin to show the complexity of species associations in the Appalachian Station's territory. Actually, there are more than 100 important but more or less localized forest types significant from the standpoint of practical silvicultural operations. Forest management research to date has been restricted largely to the upland hardwoods and loblolly pine-hardwood types which, together, comprise about 53 percent of the forest land in the area shown on the map.

C O N T E N T S

	Page
Regional Forest Types	1
Station Organization	5
Director's Foreword	7
Forest Survey	9
Inventory cruise of Virginia completed ahead of schedule . .	9
Survey reports issued for North Carolina units	9
Timber volumes in North Carolina exceed previous estimates .	9
Timber consumption also greater than estimated	10
Survey findings aid industrial development	10
Survey findings have wide use	11
Extension of Forest Survey to West Virginia, Kentucky, and Tennessee	11
Silviculture	12
The major problem in southern pine silviculture	12
Mortality follows partial cutting in loblolly pine	13
Rodents, deer, or trees?	13
Sprouts can be kept at a minimum	14
Alinement chart for classifying cut-over areas	14
Thinning produces heavier, better, and more rapidly growing white pine stands	14
Regeneration	16
The right tree in the right place	16
New light on planting to reinforce poor or understocked stands	17
Food and home preferences influence rodent damage to plantation	18
Planted red spruce saved by reducing firecherry cover . . .	18
"Unplantable" areas may be plantable by proper methods . . .	19
Progeny from different parent trees show growth differences .	20
Spot seeding of pine gives good results	21
Mensuration	22
More accurate, more useful volume tables	22
To predict growth in mountain hardwoods	22
Sawlogs or pulpwood?	22
Volume tables for oak topwood	23
Contributions to mensuration technique	23
Fire Studies	24
Measuring the influence of solar radiation upon forest fuel moisture	24
Importance of terrestrial radiation	24
New eyetest	25
Fire damage appraisal simplified by new method	25

	Page
Fire Weather Warnings	27
Controlling Forest Diseases	28
Little-leaf disease, a serious disturbance of shortleaf pine.	28
Decay in sprout oaks	29
Mimosa wilt	30
Plantation diseases	30
CCC service	30
Controlling Forest Insects	31
Forest Influences	33
New technic developed for watershed management research . .	33
Cutting the forest changes the water yield	34
Well records aid land use studies	35
Roadbank naturalization findings widely applied	36
Flood Control Surveys	37
Surveys now in progress on 7 watersheds	37
The August 1940 floods	37
Range Research	40
Station begins grazing research	40
A new-old range country	40
Beef cattle producer faced with many problems	40
Foresters are interested	41
Summary of plans for 1941	42
Forest Management Research	42
Forest Influences Research	43
Forest Survey	44
Range Research	44
Flood Control Surveys	44
Publications by staff in 1940	46



ORGANIZATION OF THE APPALACHIAN FOREST EXPERIMENT STATION

The Appalachian Forest Experiment Station is one of 13 regional experiment stations maintained by the Forest Service of the U. S. Department of Agriculture. The territory assigned to the Appalachian Station is shown in several of the maps illustrating this report; it includes public and private forest land in Virginia, West Virginia, North Carolina, South Carolina, eastern Kentucky, eastern Tennessee, and northern Georgia.

The work of the Station is organized -- as indicated by the chart, opposite -- to meet rather well defined groups of regional problems. These are:

FOREST SURVEY

A nation-wide project the object of which is to take stock of the forest resources of the United States -- (1) Inventory by groups of counties and by states, the quantity of timber, its kind, present condition and location, the extent and character of forest lands. (2) Determine the amount added to this basic stock annually through net growth; i.e., growth minus normal mortality. (3) Find out how much is taken annually from the basic stock by commodity drain. (4) Estimate probable future wood requirements.

FOREST MANAGEMENT RESEARCH

As the name states, this Station division deals with timber production, protection and harvesting. Research centers around four main projects: (1) Regeneration -- the reproduction of timber stands by natural seeding from nearby trees or by artificial means such as seeding and planting. (2) Silviculture -- weeding, cleanings and other improvement measures in young stands; thinnings in older stands; methods of harvesting the final crop. (3) Mensuration, or forest measurements -- determination of growth rates, construction of volume and yield tables, growth prediction methods, timber cruising methods. (4) Fire Studies -- development of improved methods of fire prevention, detection and suppression; measurement of the tangible and intangible effects of fire; economics of fire control activities.

FOREST INFLUENCES RESEARCH

Another name for this Station division could be watershed management research -- problems of water production, regulation of streamflow, prevention and control of soil erosion. Closely allied with forest management research, range research and flood control surveys.

FLOOD CONTROL SURVEYS

In cooperation with the Soil Conservation Service and the Bureau of Agricultural Economics, a major Department of Agriculture activity.

Deals with control of destructive floods by adjustments in land use practices. Closely coordinated with the flood control work of the War Department (flood control by means of dams and other engineering structures). Work of the Station concentrated on development of detailed plans for flood control action programs.

RANGE RESEARCH

Range management research is concerned with grazing of domestic livestock on forest lands -- determination of grazing capacities of range lands, control of poisonous plants, restoration of run-down ranges, methods of managing ranges to obtain sustained high yields of meat, economics of forest land grazing. Closely allied with forest management and watershed management research. At the Appalachian Station, this work is a cooperative project with the Bureau of Animal Industry and the State Agricultural Experiment Stations.

COOPERATING AGENCIES

Also headquartered in Asheville and closely cooperating with the Station are units of Forest Pathology and Forest Entomology research of the U. S. Department of Agriculture and the Fire Weather Warning Service of the Weather Bureau, U. S. Department of Commerce.

DIRECTOR'S FOREWORD

Because I want you to read it I have made this report just as brief as I reasonably could. It may be too brief. If so, I suggest that you write me for more detailed information on the items in which you are interested.

The report covers only the highlights of actual accomplishments during 1940. Some current studies are not mentioned because results will not be available until sample plots are remeasured or for some similar reason. Though I hope implied throughout, there is no attempt at formal analysis of regional problems and the place of forest research in helping to solve them. These problems are well known to a majority of those receiving this report and I doubt if I need to repeat them every year.

On the whole, progress during 1940 was satisfactory. We accomplished less in some respect, more in others, than the goal we set up for ourselves a year ago. Many studies are beginning to pay dividends and I am gratified to see research results applied on an ever widening scale. We added one new line of work -- range management research -- in the last few months of 1940. In co-operation with the Bureau of Animal Industry and the State Agricultural Experiment Stations these studies unquestionably will be a real influence in guiding a swiftly developing new industry in the Coastal Plain.

We are not yet making more than a piecemeal attack on one of our most important forest management problems -- determination of the best silvicultural system for Southern pine forests -- and I see no hope of greater progress with present finances until equally urgent studies in other forest types can be finished. Nor is there much prospect for starting the forest products research so urgently needed -- the development of products which will create new markets and expand present markets, and will utilize the large volume of material now considered unmerchantable. Extension of the forest survey to West Virginia, Kentucky, and Tennessee will require about 2 years per state with present funds. A relatively small strengthening of watershed management research would enable the Station to really capitalize on the work so far done and make results available for practical use very soon. These are weak spots where the Station can not provide information requested in ever increasing volume.

The space required to tell, even sketchily, of our major research jobs makes it impossible to say very much about the many interesting and unexpected by-products of research -- things we

discovered when we were looking for something else. For example, out of a study aimed at finding the cheapest but most efficient spacing of fire lookouts have come glare-reducing goggles, smoke pots suitable for sky-writing, an exposure meter usable under artificial lighting, an instrument to measure atmospheric clearness, a simple method for measuring the wave length of light, a haze meter for fire lookouts, a special "easy-on-the-eyes" paint for the interior of lookout houses, and a new kind of eyesight test to select men with "eagle eyes" for fire lookout service.

Indeed, there is never an end to research because one finding inevitably leads to another. To name but one instance, a study of fuel inflammability (to reduce the cost of forest fire control) led into fundamental studies of solar radiation (heat toward the earth) which led us to terrestrial radiation (heat away from the earth) and as a side-issue to that we found a way to freeze water in the open air on a sunny afternoon when the air temperature was 54° F. This, in turn, will suggest to researchers elsewhere a possible method for collecting water from the air in regions where water for domestic livestock is scarce.

One word more. Never have our natural resources been more at a premium than now when our country is on the threshold of a defense program that may tax these resources to the limit. Restorative measures are called for wherever past neglect or mismanagement has lowered the potential value of forests and streams. If prescriptions for restorative measures can not now be written -- and in too many instances they can not -- a workable formula must be found. This need may be no more urgent than it has been in the past; but the times give it special significance. These problems of timber production, stream flow, and the like on which the Appalachian Forest Experiment Station is working thus have an especially practical bearing on situations like the one we now face.

T. E. McAuley

Director.

THE FOREST SURVEY

Inventory Cruise of Virginia Completed Ahead of Schedule

One of the major accomplishments of the Forest Survey during the past year has been the completion within 10 months of inventory work for the entire state of Virginia, a job originally expected to require two full field seasons. Using the standard Survey cruising pattern -- sample plots every 10 chains on parallel lines spaced 10 miles apart -- a detailed sample of timber conditions throughout the state has been obtained. Over 4,000 miles of line were run and over 32,000 plots were examined ranging in diversity from the deep bogs of the Dismal Swamp to the 5,000-foot crest of White Top Mountain.

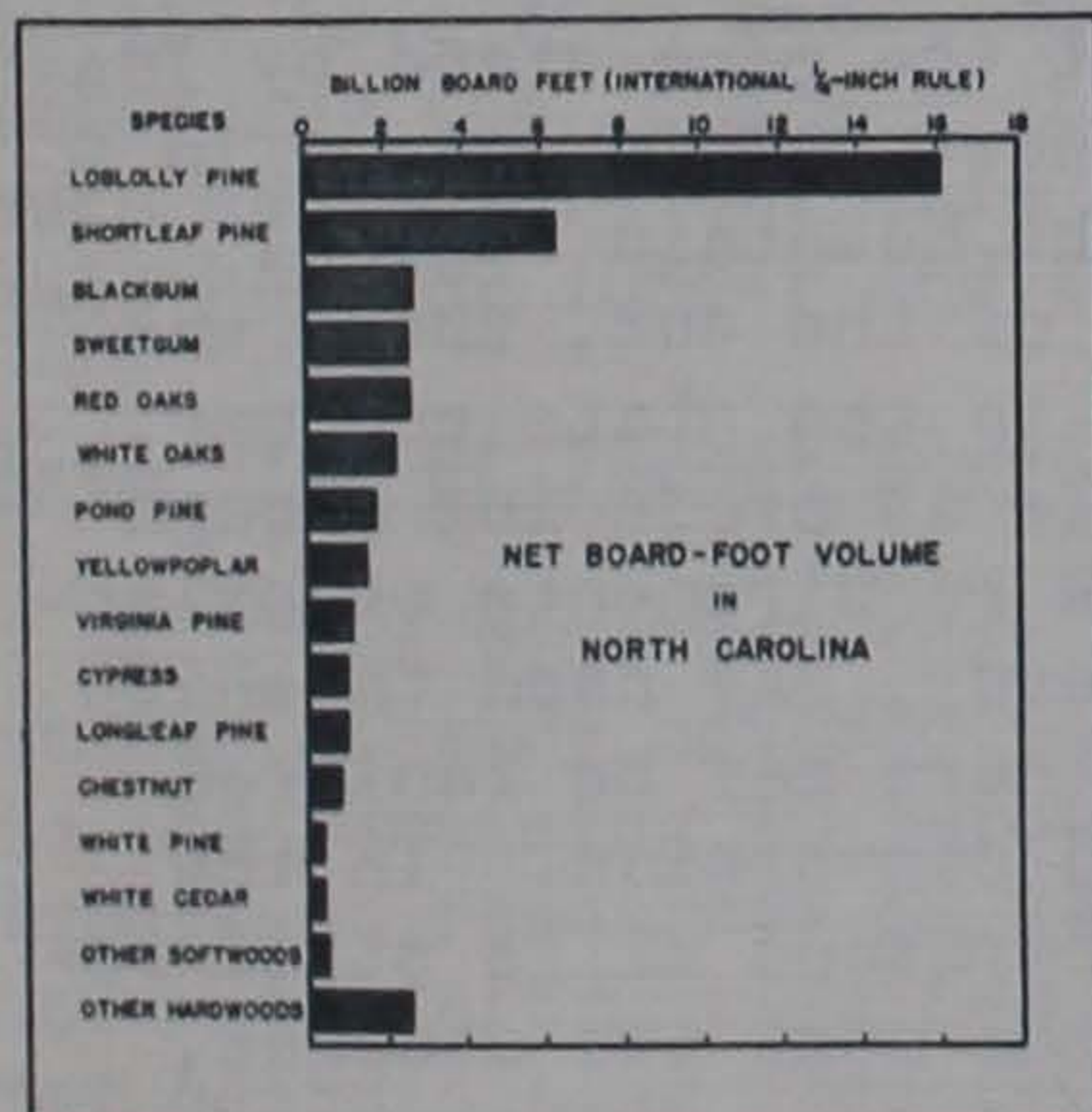
The task of tabulating and computing this mass of data is already underway. Because of the heavy demand by public agencies and wood-using industries for information regarding the forest resources of the Coastal Plain portion of the state, that important timber producing region will receive first attention.

Survey Reports Issued for North Carolina Units

Another major accomplishment has been the completion of the growth and drain computations for all North Carolina Units and the preparation and release of reports of Forest Survey findings in North Carolina. During the year three unit reports dealing with the forest resources and industries in the Coastal Plain and Piedmont regions of the state were issued. A fourth report on the Mountain region is ready for publication.

Timber Volumes in North Carolina Exceed Previous Estimates

Survey findings have altered materially some of the previous concepts regarding the forest situation in North Carolina and have contributed immeasurably toward a better understanding of forest conditions in the state. Although the acreage of forest land was found to be slightly less than previously estimated, the volume of sawtimber was considerably greater, amounting to nearly 44 billion board feet as compared to previous estimates of 19 billion.



The volume of loblolly pine alone exceeded 16 billion board feet. Fifty-three percent of the forest land contained timber of sawlog size and only 2 percent was classified as non-restocking clear cut land. To offset these favorable factors much of the forest area was found

to be poorly stocked and has a high proportion of cull trees and low value species. The average stocking of pine stands, for example, was less than half of the productive capacity of these sites.

Timber Consumption also Greater than Estimated

The mill-to-mill canvass of wood-using industries found approximately 3,200 mills operating in North Carolina in 1937, more than three times the number previously reported. Nearly 3,000 sawmills operated in the state, producing 1-1/2 billion board feet of lumber. In that year North Carolina ranked first in the South and fourth in the Nation in lumber production. A variety of other types of wood-using industries also operate in the state ranging from huge pulp and paper mills with hundreds of employees to small shingle mills and shuttle block mills employing only one or two persons. Altogether the forest products industries consumed about 2-1/3 billion board feet of sawtimber and provided about 50,000 man years of employment.

Survey Findings Aid Industrial Development

The long-time prosperity of the people of North Carolina depends upon a balanced combination of land-use and industry. The forest products industry, ranking in importance after textile and cigarette manufacture, provides an unusual opportunity for integrating the local production of raw material with local manufacture of the finished product. Perpetuation of present industries upon a sound basis, or the establishment of new wood-using plants, requires a thorough knowledge of timber volumes and forest increment and drain, both for the state as a whole and within certain regions of the state. Survey findings go a long way toward providing this information.

Briefly, it appears that for North Carolina as a whole there was in 1937 (the year of inventory) a small decrease in pine sawtimber and a slight increase in hardwood sawtimber. This, however, does not apply to individual forest regions in the state; in the Coastal Plain pine increment exceeded drain by 159 million board feet, while the mills of the Piedmont overcut the pine stand by 184 million feet. Hardwoods of sawtimber size increased in volume in both the Coastal Plain and Piedmont but in the Mountain region, where hardwoods form the most important part of the cut, there was a small deficit. Relating more specifically to the state economy, these findings mean that the forest as a whole is producing enough wood to meet domestic needs and to supply the requirements of existing wood-using industries. Some plants, however, may need to shift from the Piedmont to the Coastal Plain and others may be replaced by larger units specializing in chemical wood conversion. In the mountains it is probable that the few large hardwood mills still remaining will be forced to close down within the next two decades,

but soon thereafter the extensive stands of young second-growth hardwood should greatly augment the supply of sawtimber. In making these facts known to the people and forest industrialists of North Carolina the Forest Survey is laying the groundwork for sound industrial development that means steadier employment and more permanent forest industries.

Survey Findings Have Wide Use

Even before the unit releases for South Carolina and North Carolina were issued, requests for Survey information began to be received from foresters, land-use planners, and wood-using industries. As the work of the Survey became better known the number of such requests has greatly increased and their handling has become an important part of the work of the staff.

Forest Survey data were used in the preparation of the Forest Service Report to the Joint Congressional Committee and of the reports of the National Resources Committee. Other federal agencies such as the Bureau of Agricultural Economics, the Soil Conservation Service and the Tennessee Valley Authority have requested special tabulations of Survey data to aid in analyzing local land-use problems. The State Forest Services and Extension Services have also used Survey information as a basis for developing their programs and as a means of presenting their forest problems to the public.

The Appalachian Station itself has drawn heavily on the Survey data. Forest management research has found these data particularly valuable in its fire damage appraisal studies, and in the construction of standard volume tables for the principal species in the Station's territory. Flood control survey units have assembled Forest Survey data by watersheds for the forestry sections of their reports.

Pulp and paper companies have relied on Survey estimates in the determination of possible mill locations and have consulted with the Survey staff regarding the desirability of proposed sites from the aspect of timber procurement. Investment companies have also made use of our data in evaluation work. In addition, numerous requests have been received from wood-using industries for information regarding the location of timber of a particular species or quality, such as hickory suitable for ski stock, white oak for stave material, chestnut for lumber and for acid wood.

Extension of Forest Survey to West Virginia, Kentucky, and Tennessee

The wide use that is being made of Survey information in the states already covered indicates the need for completing the work in the remaining 40 percent of the Station's territory. Forests are important resources in West Virginia, Kentucky, and Tennessee and accurate information regarding them is urgently needed as a basis for coordinating industrial planning with land-use and as a means of helping to solve the serious social problems existing in parts of these states.

SILVICULTURE

The Major Problem in Southern Pine Silviculture

Which form of management -- even-aged or many-aged -- will yield the greatest long-time net income from a given stand? This is a top priority problem in management of southern pine forests. Most foresters now strongly favor many-aged management but there is reason to believe that for pine forests in the Carolinas and Virginia some form of even-aged management would be better.

The relative merits of the two systems are affected by a number of factors, such as the silvicultural characteristics of the species, the specific stand conditions, the economic forces operating, and the kinds of products to be grown. More basic information on these factors must be obtained before the Station will recommend any system of management. The information required is being obtained as rapidly as possible, considering the extremely small allotment available for forest management research in pine types. Results of present studies have revealed the specific nature of a hardwood invasion that is taking place in pine stands, and some of its implication in pine silviculture; have shown the need of considering the mortality of residual trees; have given the effective seeding radius of solid bodies of pine timber; and have summarized the seeding characteristics of loblolly pine.

Thus, as with a jig-saw puzzle, a number of parts may be missing but enough key pieces have been fitted together so that a general picture is becoming apparent. This picture, however, is somewhat different from the concept of management now generally accepted for the older second-growth forests of Virginia and the Carolinas. Its most important difference seems to be the doubt that tree selection is the most desirable form of management for pine forests -- in these three states, at least.

Tree selection depends for success, over a long period, upon the production of many-aged stands but these may be almost impossible to maintain without reducing the volume of pine in favor of low-valued hardwoods. The alternative, even-aged management which depends upon clear-cutting, has been frowned upon because it is thought to provide too much leeway for devastation, seems to violate the fundamental rule that a large growing stock constantly should be kept on the ground, and for other reasons. But there is a concept of even-aged management which envisions continuous production on a single property and at the same time exercises economic selectivity, a selectivity by stands rather than by individual trees. These stands may

be small groups, narrow strips or even fairly large blocks. This is not a new type of forest management but apparently it has been overshadowed in the past few years by considerable publicity on the tree selection system.

Mortality Follows Partial Cutting in Loblolly Pine

Mortality of residual trees following the partial cutting of some loblolly pine stands is so high that only a slight net increment is attained by the reserved stand during the first decade following cutting. Analysis has just been completed of the growth and mortality in two stands of loblolly pine partially cut 10 years ago. In 10 years approximately 70 percent of the reserved 6-inch trees died, 35 percent of the 8-inch, 20 percent of the 10-inch, and about 10 percent of the larger trees. Although the mortality of the smaller trees in the stand represents a low board-foot volume loss, the silvicultural significance is great. These trees constituted a large portion of the growing stock; they were of high potential value, were intended to form the bulk of future harvests, but turned out to be an economic loss.

Rodents, Deer, or Trees?

Preliminary results from studies in progress by the Station show that for every new oak seedling in the spring, 40 acorns must be produced the previous fall. Eight of the 40 acorns will be destroyed by rodents or birds while still on the tree, 8 damaged by insects, 7 not viable, and 16 will be consumed by rodents or deer after falling to the ground.

With loblolly pine an even greater difference exists between the number of seed produced and resultant seedlings. For every 300 seed produced during a single year, only one established seedling can be found two years later. Birds, rodents, weather conditions, and competing vegetation are the principal factors contributing to seed loss and seedling mortality in loblolly pine.

Similarly, when yellowpoplar seed trees were left after clear-cutting the remainder of the stand, a yearly average of about 150 seedlings was established for each seed tree reserved.

From these results it is concluded that in order to obtain 1,000 seedlings during a 5-year period, 8 oak trees at least 20 inches in diameter, or 2 pine trees 15 inches in diameter, or 1-1/3 yellowpoplar trees must be left per acre as seed trees.

Sprouts Can be Kept at a Minimum

To kill back undesirable trees and reduce their subsequent sprouting, poison them with sodium arsenite at the end of the seasonal spring growth. Poisoning costs about the same as girdling with an axe -- approximately 2 or 3 cents for a 10-inch tree -- but appears to be more effective.

These results were obtained from a 9-year test of poisoning and girdling undesirable Appalachian hardwoods. It was found that half of the poisoned trees, and three-fourths of the girdled trees, produced sprouts. Of these, the girdled trees bore twice as many sprouts as the poisoned trees.

Theoretically, sprouting will be kept at a minimum if trees are cut at a time when most of the reserve food has been expended for early spring growth before the plant has a chance to manufacture and store more food. Depending upon the locality, this period is roughly from June 15 to July 15. The theory was checked by cuttings of dogwood, sassafras, firecherry, and sourwood in several localities for a number of years and results were compiled by the Station in 1940. Sprouts arising from these summer-cut trees were significantly fewer, smaller, and less vigorous than those resulting from cuttings made during other periods of the year.

Alinement Chart for Classifying Cut-over Areas

An alinement chart for rating the qualities and promise of cut-over areas in the Appalachian Mountains was prepared by the Station in 1940. The chart offers possible aid in planning the large-scale restoration of such areas. Heretofore a clear perception of this task has been difficult because of the great variation between individual cut-over areas, and the lack of a standard basis for their classification. The principal advantage of the new method is that it visualizes, by means of a simple scale, the goodness or poorness of an area in terms that are comparable with other areas. It furnishes a rating of the area not only in a general way but also with respect to the adequacy or deficiency of each desirable element in the stand -- good timber trees, good poles, or good saplings. It diagnoses the area as to the degree of its goodness or poorness in one, two, or all three respects, which is the first step toward formulating methods for making cut-over areas fully productive.

Thinning Produces Heavier, Better, and More Rapidly Growing White Pine Stands

Successive thinnings conducted by the Station in a white pine plantation on the Biltmore Estate, near Asheville, have resulted not only in larger and better trees but also in a heavier stand per acre and in more rapid growth than were produced without thinning according to an analysis made in 1940.

There have been four thinnings since the experiment was started in 1916 in an 18-year-old stand. During the 19 growing seasons up to the time of the latest thinning, in 1936, the annual growth per acre (total stem volume without bark) of the thinned stand was 131 cubic feet, whereas that of the unthinned control plot was only 99 cubic feet.

The volume of the wood removed in the four thinnings averaged 112 cubic feet per acre per year, so that the average annual total production of the thinned stand amounted to 243 cubic feet per acre. Reduced to merchantable content of peeled wood in sticks 4 inches in diameter and larger at the small end, this is equivalent to more than a standard cord per acre, as compared with about half a cord for the unthinned stand.

The successive thinnings took out the smaller and poorer trees and left the larger and better, so that the superior growth rate of the thinned stand was concentrated upon trees of higher quality than in the unthinned stand. In 1936 the volume per acre in trees 6 inches and larger in diameter was 3,226 cubic feet in the thinned as compared with 2,946 cubic feet in the unthinned stand, a difference of 9.5 percent. In trees 8 inches and larger the volumes were 2,262 and 1,580 cubic feet; the difference in favor of the thinned stand was 43 percent. In trees 10 inches and larger the thinned stand was 79 percent better than the control. Thus the thinning not only supplied a yield of merchantable wood amounting to about 0.9 of a cord per acre per year but also resulted in a material improvement of the stand quality.

REGENERATION

The Right Tree in the Right Place

Progress toward this goal, long sought by tree planters, was made during the year for planting in the Great Appalachian Valley and adjacent mountain regions. Instead of one or two species, possibly a number of commercially valuable species and mixtures of species may be used successfully, if proper attention is paid to site and soil conditions. This is strongly indicated by results summarized in 1940 of experiments conducted by the Station in cooperation with the Forestry Relations Department of the TVA.

Survival and growth, 3 years after planting, on over 250 experimental plots on 2 extensive soil series (data on another soil series not yet summarized) have shown that 5 species and 4 mixtures of species can be planted successfully on soils derived from dolomitic limestone and shale. Abbreviated planting specifications follow. They are based on third year results, and are recommended for old fields in the Appalachian Valley and adjacent mountain regions.

A planting survey of a 2,800-acre tract of woodlots and old fields TVA land has been completed using essentially these specifications. About 720 acres were found open or only partially restocking, and 103 sites for plantations of the above species or mixtures were located, mapped, and will be planted early in 1941. This will serve as a proving ground for the experimental results upon which the specifications are based. The use of planting specifications such as these (they will be improved as additional results become available) will help to get "the right tree in the right place". Such knowledge will give the forester and farmer some assurance that muscle and money spent on tree planting will be wisely spent.

PLANTING SPECIFICATIONS FOR APPALACHIAN VALLEY

<u>The Right Tree</u>	<u>The Right Place</u>
Shortleaf pine	Southerly or southwesterly slopes or ridges and badly eroded northerly slopes; never in very dense briars, weeds, or overhead shade.
Eastern white pine	Fair to good northerly or easterly slopes or the best uneroded ridge tops and gentle southerly slopes; a gravelly, sandy, or silty A horizon at least 5 inches in depth and a B horizon not heavier than a loamy clay, never in the densest vegetative competition.

Yellowpoplar	The better northerly or northeasterly slopes, "sinks", coves, and well drained bottoms; a loose, friable A soil horizon at least 7 inches in depth; a well drained and aerated B horizon not heavier than a loamy clay in the lower part or a clay loam in the upper. Depth of soil down to C horizon at least 2, and preferably 3 or 4 feet. Dense competition is not harmful. In partial shade the site requirements can be reduced slightly.
Black walnut	Small groups on yellowpoplar sites (above) or better. "Sinks", coves, and well drained bottoms are best.
White ash	Small groups on the best yellowpoplar sites characterized by well aerated, deep soils with a good moisture supply.

All Mixtures Checkerboard: 9-Tree Squares

Shortleaf pine - yellowpoplar mixture	Northerly or northeasterly sloping yellowpoplar sites where vegetative competition is not above moderate.
White pine - yellowpoplar mixture	Fair to good northerly or easterly slopes. In general, the better white pine and poorer yellowpoplar sites (above).
Shortleaf - white pine mixture	The better than average white pine sites.
Yellowpoplar - black walnut mixture	"Sinks", well drained bottoms and the best northerly slopes. Dense competition is tolerated. Mixture should be 2 to 1 in favor of yellowpoplar.

New Light on Planting to Reinforce Poor or Understocked Stands

Yellowpoplar, white pine, and in some cases, shortleaf pine have been successfully used as interplantings and underplantings in the Great Appalachian Valley. This has been indicated by early results from experimental plots. Abandoned fields often come in to more or less dense stands of sassafras and associated small woody tree species. Sassafras, especially, is a soil builder and casts such a relatively light shade that yellowpoplar is benefitted rather than harmed by all except the densest stands. White pine has also shown excellent growth under all but the very dense stands, and shortleaf pine is satisfactory on the poorest soils where the overstory is sparse.

Sparse stands of young, nearly even-aged shortleaf pine with large spaces between trees occupied by broomsedge can be successfully interplanted with one or more of the same three species.

In both under- or interplanting of sassafras and interplanting of pine, yellowpoplar should be used on the northerly or easterly slopes with good soil, white pine on the average sites but avoiding steep south exposures, and shortleaf pine on the most exposed sites with the least overstory.

The conversion of brush fields or greatly understocked stands into productive forest can often be accomplished by a small amount of planting of the right species. Too often in the past such lands have been regarded as restocked and so neglected, with a consequent loss of wood increment of desirable quality.

Food and Home Preferences Influence Rodent Damage to Plantation

Rodents have a preference for living quarters and food, and this has a real influence on planting in the Appalachian Valley as shown by the Station's experimental planting plots. As a home they apparently prefer dense broomsedge cover, the denser the better, and as tree food they prefer in about the following order: (1) roots of oak seedlings, (2) red gum bark and stem, (3) white ash bark and stem, (4) black locust bark and stem, (5) black walnut and yellowpoplar bark and stem. They also like acorns but rodent damage in direct seeding of oak was not serious because most of the acorns sprouted and came up before being found by rodents. The greatest damage occurred to seedlings after the acorns were completely absorbed and during the second and third summers.

Aside from the oaks only red gum suffered serious and consistent damage. Yellowpoplar and walnut injuries were "spotty" and not a limiting factor except in the most heavily infested areas. Shortleaf and white pine were not affected.

Planted Red Spruce Saved by Reducing Firecherry Cover

The 1940 examination of red spruce planted under firecherry stands of different densities showed heavy losses the first season after planting unless released from full overhead shade. Twelve experimental planting blocks in North Carolina and West Virginia indicate that an opening, 10 to 12 feet in diameter at mid-crown level, cut in early July after planting makes the difference between life and death for the tiny red spruce trees planted under the densest stands of firecherry. In the following table thrifty trees are considered those having a good chance to live through another season.

FIRECHERRY COVER

PERCENT OF PLANTED RED SPRUCE TREES IN THRIFTY CONDITION

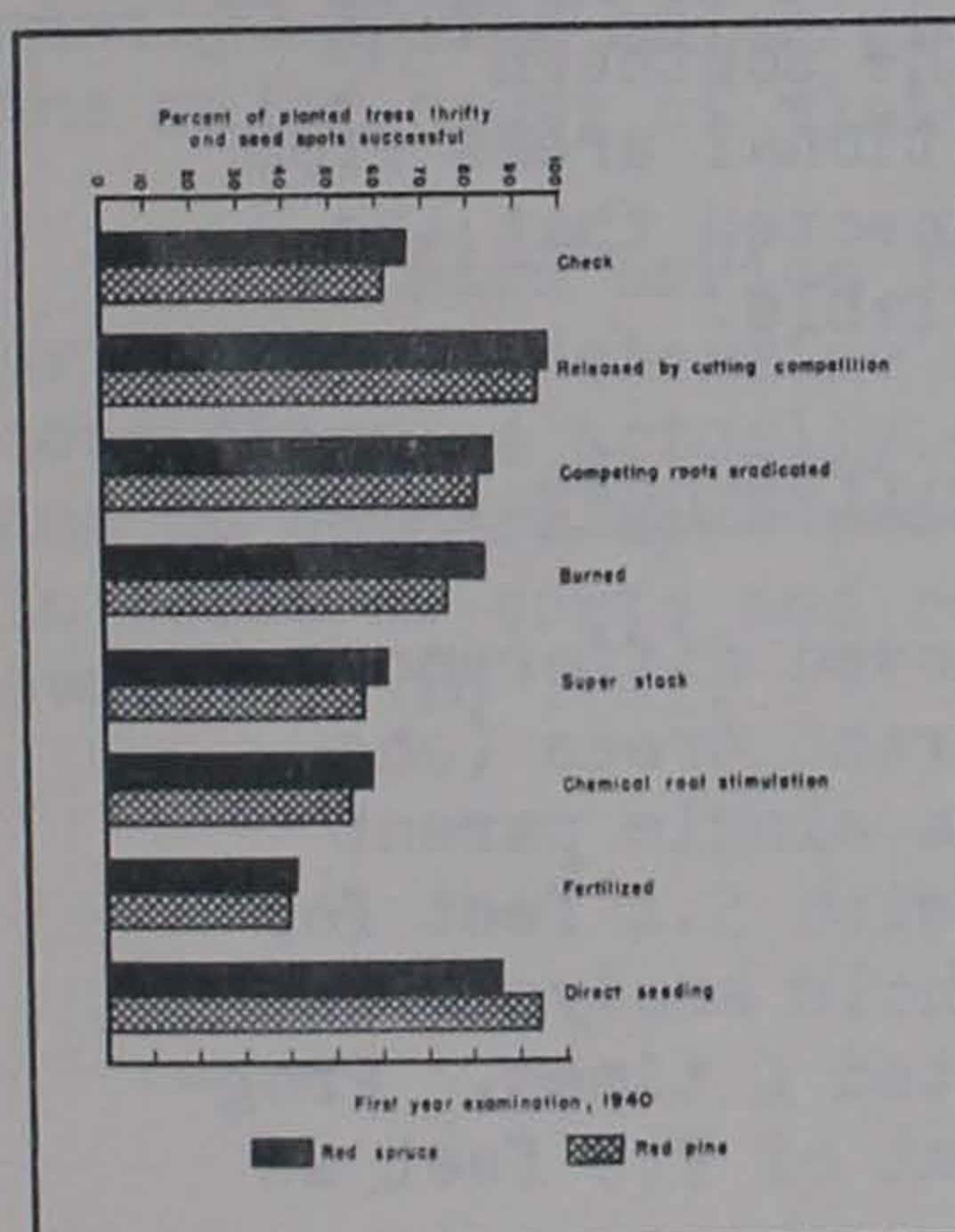
	<u>Released</u>	<u>Not Released</u>
Dense	73	23
Medium dense	89	63
Least dense	82	70

Additional release cuttings will be made at planned intervals so as to learn when release should be made and how large an opening is necessary for certain types of worthless hardwood stands, mostly firecherry, which are characteristic of the cut and burned over spruce type.

In the dense stands the percentage of planted trees considered thrifty was higher where an opening 10 to 12 feet in diameter was cut than for a 6 to 8 feet opening. The percentages were 72.6 and 60.4, respectively. In the stands of lesser density no differences between the two sizes of openings were apparent.

Some day, the worthless stands of hardwoods on spruce soil and in spruce climate should be converted into timber producing areas. What part planting may play in this conversion will depend upon (1) whether or not planting can accomplish the conversion and (2) the costs of the methods necessary to success. Present experiments are designed to determine the methods necessary for conversion. Later the most successful of these will be tested on a large scale to determine costs.

"Unplantable" Areas May be Plantable by Proper Methods



Areas in the spruce type which have been considered unplantable because of severe mortality of planted trees caused by excessive competition of blackberry, bracken fern, etc., give promise of response to certain treatments now being tested by the Station. Results in 1940 indicate that direct seeding, release cutting of competing vegetation and, in some types, burning will give success combined with reasonable economy. Another treatment consisting of a 3-foot spot in which roots were eradicated was successful but will probably be too expensive. The use of so-called "super stock", fertilizer, and chemical root stimulation with hormone-like substances and vitamin B₁, gave results

considerably poorer than the check, i.e., regular planting technique.

The trend shown in the graph will continue for several years as other studies have shown that in dense vegetation, mortality continues until the stronger planted trees become firmly established and

are at least partly freed from complete overhead shade. It is expected that differences between (1) treatments providing for some reduction of competition, and (2) methods not so providing, will increase in the next few years.

Screened seed spots, as judged by success at the end of the first season, have been successful both for areas of very dense competition and on those so barren and rocky that planting is exceedingly difficult and ineffectual. On these barren areas red spruce and southern balsam fir were direct seeded in small prepared spots, mulched, and screened. Exact figures are not yet available but 85 to 90 percent of the spots are successful with an average of 4 to 6 seedlings per spot. Southern balsam fir and red pine have both proven somewhat superior to red spruce in direct seeding.

Aside from protection from birds and rodents, screens on seed spots in the spruce type where vegetation is often very heavy serve to prevent the small seedlings from being completely covered by leaves and other debris which accumulate on the ground in the fall. Seedlings in spots not screened were completely covered by leaves in October and the addition of snow would smother many of them.

The decision as to how much reforestation in the spruce type can be done by direct seeding depends upon the ultimate success of direct seeding versus planting, and the comparative cost of the two methods. Red spruce planting stock is expensive and this fact leaves considerable leeway for use of screens. The field work of direct seeding costs about the same as for planting.

A knowledge of the most successful and economical methods of reforesting cut and burned spruce type lands in the southern Appalachians will assist in converting large additional areas from the unplantable to the plantable class. It is expected that the Station's program will make this information available.

Progeny from Different Parent Trees Show Growth Differences

Four-year-old loblolly pine plantations showed differences which apparently can be attributed only to the parent trees (one parent). Four plots of trees grown from seed of a single parent tree had a mean height of 8.3 feet as contrasted with 5.4 feet for 4 plots of trees from another parent tree. The whole analysis included progeny from 105 parent trees each replicated 4 times. Progeny from the best 10 parent trees had a mean height of 7.5 feet as contrasted with 5.6 feet for the lowest 10.

An attempt has been made to isolate parent tree differences which can be correlated with growth of progeny but so far without success. The data, however, do apparently show that growth vigor is inherited, even from one-parent, i.e., the seed bearing tree. This will have an important bearing on seed tree selection and seed collection if it can be tied down to recognizable parent tree characteristics or locality of growth.

Spot Seeding of Pine Gives Good Results

Results of recent tests by the Station make it appear likely that spot seeding will become a practicable method of pine reforestation in the Piedmont region. Because it follows nature's method so closely, the direct sowing of seed, as opposed to the transplanting of artificially raised seedlings, has always appealed to foresters, and the possibilities of savings in planting cost has further attraction. Consequently there have been many experimental trials of both broadcast and spot seeding, heretofore with little success.

In 1938 the Appalachian Station began experiments with spot seeding of pine on small patches of soil previously prepared. These tests were continued in 1939, and in the winter of 1939-40 further tests were made of the most promising leads. While the results do not imply that spot seeding will displace planting, they do suggest that spot seeding will be a useful adjunct to planting, applicable particularly to certain site conditions, enabling reforestation activities to be expanded beyond the limitations of nursery capacities.

Conclusions thus far reached in this study are: Fall or early winter seeding gives from two to four times better germination than spring seeding. Loblolly pine gives higher germination and apparently greater survival also than shortleaf pine or Virginia pine. Drought, rather than heat injury, is the paramount cause of early pine seedling mortality in the region studied. For maximum germination and subsequent survival, scarify, mulch and screen, but good results are obtainable even without screens. Partial shade definitely favors germination and first-year survival -- sometimes doubling germination -- and is a practical measure on certain sites or types of operations. A simple, easily applied mulch protects seedlings from frost heaving, apparently the major cause of winter mortality.

A third series of spot seedings was made in the fall of 1940, primarily to determine the cost of spot seeding under ordinary field conditions as actually encountered in large-scale planting operations and to compare spot seeding and planting under identical conditions in terms of costs and results. Results from these tests will be available in 1941.

MENSURATION

More Accurate, More Useful Volume Tables

Regional volume tables based on form as well as the d.b.h. and height of trees are more accurate for local application than local volume tables based on d.b.h. and height only. Furthermore, a single form class volume table often may be made to serve for several species. For example, volumes of 16 Appalachian species can be read from only 6 volume tables, each table applying to a group of species.

These are some of the conclusions, soon to be released as a technical note, which have been drawn from an analysis made in 1940 of the board foot volumes, diameters, and heights of 3,778 trees from the 8 states in the Station's territory. Form as used here is defined as the ratio of the diameters outside bark at the top of the first 16-foot log and at breast height. In order to apply form class volume tables, it is necessary to measure this upper diameter as well as diameter at breast height.

The publication of these volume tables will complete this Station's efforts to provide accurate board foot volume tables for mountain hardwoods. Present demand is for local tables and these to be issued by the Station probably are about as accurate as empirical tables can be made for local use. Any further increase in accuracy of regional tables for local application must depend either upon local checks and revisions of regional tables or upon construction by estimators themselves of special tables for individual localities.

To Predict Growth in Mountain Hardwoods

Rarely is there an opportunity to obtain growth and mortality figures on so large a number of plots as the Station is now using. More than 3,000 growth plots which were established 6 years ago in mountain hardwoods are now being remeasured. The information thus obtained will be used in efforts to devise a short-cut method for predicting growth in mixed hardwood stands.

Sawlogs or Pulpwood?

Now that oak is beginning to be used for pulpwood, a set of converting factors developed by the Station in 1940 will be useful in deciding whether oak bolewood will sell for more as sawlogs or as pulpwood. These factors also can be used to determine the relative value of stacked units of topwood in comparison with straight bolewood. The factors show that:

- (1) The amount of solid wood in stacks of oak topwood and crooked or knotty bolewood increases according to the proportion of round

sticks in the pile. The solid wood content of such stacks also increases as the number of sticks per stacked unit increases. Solid content of stacked (5-foot) units varies from 81 to 107 cubic feet and averages 93 cubic feet.

(2) Because the solid content of straight, split oak bolewood does not vary with the number of sticks per stacked unit, the average content of 109 cubic feet per unit may safely be used for this kind of wood.

(3) Cubic foot - board foot ratios vary so widely with diameter and length of sawlogs and with kind of log rules that it is impossible to derive a single average factor to convert board feet to number of stacked units. A whole series of such factors is needed and was developed in field studies made by the Station last year. It was found, for example, that 1,000 board feet, log scale by Scribner Decimal C Rule, would make 2.26 units of stacked wood if in 8-inch logs whereas 1,000 board feet would yield only 1.30 units if split from 20-inch logs. With the Doyle Rule, 1,000 board feet, log scale, would make 4.00 units of stacked wood if in 8-inch logs and 1.42 units if in 20-inch logs.

Results of these studies, giving full sets of converting factors, will be published early in 1941.

Volume Tables for Oak Topwood

With the aid of some rather unusual volume tables just completed by the Station it is possible to estimate amount of oak topwood in cubic feet and in stacked units according to the diameter and height of the tree, or from tree diameter alone. These new volume tables show the amount of topwood above that part of the tree bole usable for sawlogs.

Contributions to Mensuration Technique

A table of factors to convert horizontal distances to slope distances for use with the topographic Abney level and tape was published in 1940. Such tables were not available heretofore, though they are often needed when fixed distances are to be laid off on sloping ground. Another similar table of factors to convert slope distances to horizontal distances also was prepared.

Directions for making circular slide rules to solve linear equations involving single-valued functions were prepared during the past year. Many such formulas are used in forestry, some of them extremely complicated. Circular slide rules, compact and especially well adapted for use in the field, greatly simplify the use of these formulas and so may help to make their application more general.

Measuring the Influence of Solar Radiation Upon Forest Fuel Moisture

Measurement of the drying effect of solar radiation upon forest fuels has yielded information immediately useful in improving Forest Service fire danger meters. For example, in sunlight the surface litter of the forest floor strangely enough dries out faster in calm air than if the wind is blowing, and dries to the point of inflammability within 3 or 4 hours following a heavy April shower. On north slopes in the fall it takes 3 or 4 weeks of sunlight to dry fuel to the same degree of inflammability reached on south slopes in only 5 or 6 days.

These are some of the things recently learned about solar radiation in a detailed study of factors influencing the inflammability of forest fuels. The purpose of the study was to increase the dependability of the fire danger rating system for the southern Appalachian region. The system is based upon the measured influence of rainfall, wind velocity, air temperature, and relative humidity, as well as of solar radiation. Calculations, checked by field tests, soon will be available to show the rate of drying and fuel moisture equilibria expected on slopes of any steepness and aspect and for any time of day or season of the year.

Importance of Terrestrial Radiation

While studying the effect of solar radiation on inflammability of forest fuels a marked difference was found to exist between temperatures of the surface litter, and air temperature in nearby instrument shelters. This led to a study of terrestrial radiation -- radiation of heat away from forest litter.

A radiating device, or "frost pocket", was constructed which duplicated in miniature conditions found by test to occur on a larger scale in the forest. The moisture content of fuel moisture indicator sticks placed in the "frost pocket" sometimes rose overnight to 70 percent, yet similar sticks outside the chamber shaded from the clear sky and not more than 3 feet away, did not rise above 15 percent. A surprising result was that the device worked almost as well in broad daylight as at night. Water was actually frozen in the "frost pocket" on a sunny afternoon when the air temperature stood at 54° F.

The principle involved is the radiation of heat of objects or materials, on clear nights or sunny cloudless days, into space more rapidly than they can gain heat by radiation or conduction from their surroundings with consequent loss in temperature. When their temperature falls below the temperature of the dewpoint, condensation occurs.

This cooling phenomenon is well known to meteorologists, but the importance of its influence on forest fuel conditions has probably not been recognized. It has previously been assumed that north slopes make good firebreaks in late fall because they are less subject to the drying effect of sunlight, but sunlight now appears less important, or at least no more important, than terrestrial radiation. As a result, it is possible to predict the topographic conditions favorable and unfavorable to the spread of fires.

The results of the study of terrestrial radiation will contribute to the improvement of fire danger rating systems, the location of fire danger stations, and in actual fire control operations. They should also be extremely useful to agencies concerned with crop damage from frost.

New Eyetest

An eyetest announced by the Station early in 1940 already is being used to select keen-sighted observers for fire lookout duty. This test has several advantages over other eyetests; simplicity, independence of lighting conditions, gives ratings which are proportional to the visual range of small smoke columns, and determines which individuals possess "eagle eyes".

The test is given by means of an "eyetest board". Over 300 of these were used in 1940 on national forests, and present indications are that the test is giving good results under field conditions. Good eyesight is at a premium in fire detection and any such improvement which aids in selecting especially keen-sighted men and in eliminating those with faulty vision adds to the efficiency of the fire-protective organization. But the possible uses of the test extend beyond this. For example, it may prove serviceable in selecting men for duties where much depends upon ability to perceive very small objects at a distance, as in certain military work. This test, however, would not be suitable for other types of visibility requirements, such as color or depth perception or measurement of actual eye defects.

Basic research in this study has developed some interesting sidelights such as a simple method for determining the wave length of light, and an explanation of the unusual visual powers of birds of prey.

Fire Damage Appraisal Simplified by New Method

A system for appraising average fire damage in dollars per acre was developed during the year. The system is surprisingly simple and requires no detailed examination of burned areas, nor the services of expert technicians. Appraisal can be made at any time after the fire, with only these few facts at hand: the forest type (pine, pine-hardwood or hardwood); condition class (sawlog or under

sawlog size); stocking (poor, medium, or good) and fire danger class (determined by the fire danger rating system). Damage figures range from 24 cents to \$7.27 per acre.

The elements of damage included are tree mortality, cull resulting from fire wounds and decay, and to a lesser extent, loss from reduction in growth. Thus, both immediate physical damage to the stand and loss caused by delay in future returns of forest products form the basis for the system. It does not yet attempt to rate the intangibles -- damage to watershed values, fish and game, recreation, and the like. Appraisal figures, it should be mentioned, are for average stands of a given forest type, burned under average conditions of a given fire danger class.

There are many obvious advantages in having all fire control agencies rate damages uniformly. Expenditures can better be weighed against losses; one section or state can better be compared with another; regional statistics will be more reliable; allotment of fire control funds can be made on a more equitable basis; and in general, the whole structure of fire control economics will be strengthened.

FIRE WEATHER WARNINGS*

Forest-fire meteorology plays a major role in the activities of forest fire control agencies. Information on approaching weather conditions -- precipitation, temperature, humidity, wind velocity -- is essential to prepare for peak loads of fire business.

The fire-weather service of the Weather Bureau, U. S. Department of Commerce, at Asheville, N. C., distributes fire-weather forecasts for the southern Appalachian region to Federal and State agencies by telephone, telegraph, radio and newspapers. A brief summary of the organization of the Asheville District was given in last year's annual report. From a nation-wide collection of weather reports, including supplemental reports from Federal and State forest and park services, synoptic weather charts are prepared as a basis for the fire-weather forecasts sent to protection agencies during the spring and fall fire seasons.

The fire-danger rating system now used in this region provides for the prediction of severity of fire days with the aid of fire-weather forecasts. The policy is to issue and distribute weather forecasts when class 3 (or worse) fire days are expected to develop. Such extreme conditions can generally be determined from the synoptic chart. For example, a synoptic weather situation which will cause dangerous fire conditions to develop in this region, particularly in the extreme southern part, results from the rapid passage of a low pressure system over the Great Lakes Region with a frontal zone extending southward to the northern portions of the Gulf States. Immediately behind follows a mass of dry air of continental origin which rapidly overspreads the southeastern states. As the frontal zone passes over this region only light scattered showers occur, winds shift from southerly to northwesterly with increasing velocities, skies clear rapidly, humidities diminish, visibility decreases -- all indicative of an extremely dangerous fire condition. The fire-weather forecaster must be on the alert to advise protection agencies when situations such as this are likely to develop.

During the past year studies of the variation of wind velocities in the mountain areas of this region were made and have proved of considerable value in determining expected severity of fire days. Other studies now in progress may soon permit the inclusion of a statement in fire-weather forecasts of the probable fuel inflammability to be expected.

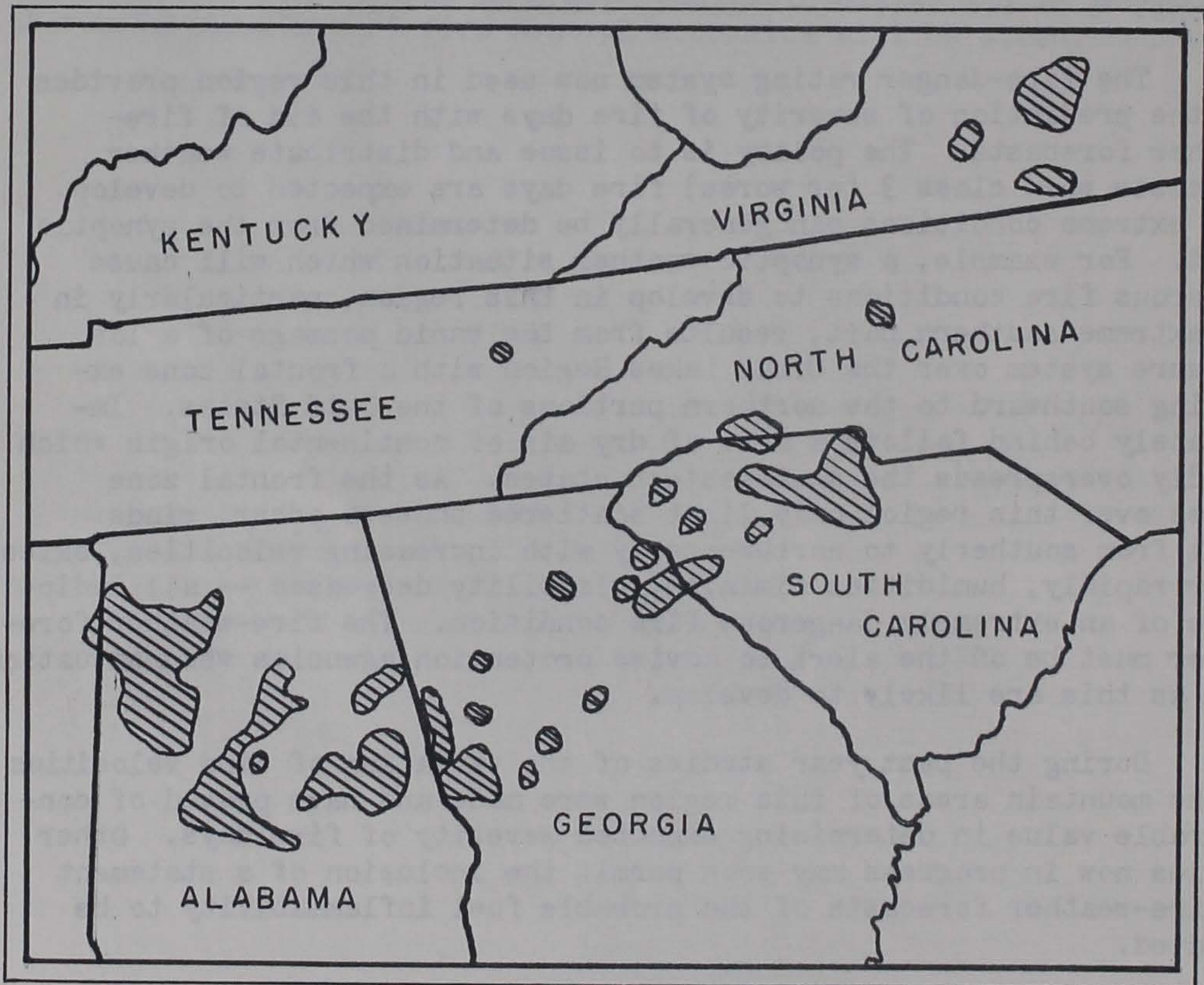
The most urgent need at present is for facilities to prepare synoptic charts based on 1:30 p.m., E.S.T., weather reports so that fire-weather forecasts can be issued in the late afternoon. This will enable forest protection agencies to formulate advance plans for suppression activities on the following day. It is expected that this improved service can be put into effect soon.

*The Station cooperates with the Fire-weather Warning Service of the Weather Bureau.

CONTROLLING FOREST DISEASES*

Little-leaf Disease, a Serious Disturbance of Shortleaf Pine

A widespread deterioration of shortleaf pine stands of pole size or larger has been taking place in many parts of the Piedmont Plateau and especially in the Upper Coastal Plain of Alabama. (See map.) Tree crowns become thin, growth is checked and then the trees die. The condition has been described as little-leaf because of the short needles, characteristic of most affected trees. The situation is so serious that it has resulted in drastic cutting of shortleaf pine in some localities to avoid heavy losses, and the discontinuance of planting shortleaf pine by many agencies in the southeast. At present there is no clue as to the cause of the trouble nor do we know whether or not it is spreading or static.



Distribution of the little-leaf disease as determined by roadside surveys up to November 1, 1940

*The Station cooperates in these studies by the Bureau of Plant Industry, U. S. Department of Agriculture.

Permanent plots to follow the progress of the disease have been established, so far, in Alabama, Georgia, North Carolina and South Carolina. A critical study of symptoms, involving determinations of radial and height growth, needle retention, needle color and length, cone production, suckering, ash and moisture analyses of foliage and wood, and other factors is under way. A preliminary study of root conditions indicates that little-leaf trees have fewer fine roots and a larger proportion of them dead, fewer mycorrhizae per foot of fine root, and have much rougher, scallier, large roots. Numerous fungi have been isolated from roots of diseased trees, but their significance have not yet been ascertained. Soil samples taken from diseased and healthy stands in 47 localities are being analyzed in an attempt to find a relationship of little-leaf to soil composition and texture. No correlation of little-leaf with weather has been found from analysis of weather records of 20 towns, 10 with little-leaf close by and 10 well away from little-leaf. Some patch grafts have been made from diseased to healthy trees, to determine whether little-leaf can be transmitted. This is part of an attempt to find out if it is a virus disease.

The most consistent habit of little-leaf is its common occurrence on poorer sites and rougher ground where farming is submarginal and where the land has largely reverted to forest; and its absence in woodlots of shortleaf pine in the better farming sections, where the topography is more rolling and the soil conditions are better.

Decay in Sprout Oaks

One-fourth of the oak sprout timber in the region extending from Virginia to Connecticut and west to Ohio is butt-rotted as a result of decay that entered the trees from the parent stumps. It seems highly likely that this great loss can be substantially reduced by taking appropriate silvicultural measures during the early stages of development of sprout stands.

Five years ago plots were established to find means of encouraging sprouts of low origin on the parent stump, since they are most likely to produce sound trees. Another experiment using different methods of eliminating individuals from sprout groups, including girdling, leaving a high stub, and cutting flush at the base, was started. A third experiment, to compare the rate of decay from cross-ties and posts cut from just above active decay of Stereum gausapatum in butt-rotted trees and ties and posts cut from sound trees was also started. Preliminary indications from the sprout origin plots are that where sprouts of high origin are abundant they had best be cut early, giving the lower sprouts opportunities to develop, since the sprouts of higher origin, with considerable likelihood to decay, are most likely to become the dominants in any given group. The experiments in thinning sprout clumps of

larger trees have not run long enough to judge comparative decay transmission from girdled trees, high stubs, and flush cuts, but a flush-cut type cutting that will leave a wound in excess of 3 inches across is likely to lead to decay. It is too early to say how far this decay will spread. The cross-tie and post experiment indicates that ties and posts with the earliest stage of heart rot of Stereum gausapatum decay somewhat faster in service than those cut from healthy trees.

Mimosa Wilt

Mimosa wilt is a virulent killer that has destroyed thousands of mimosa trees in at least 55 localities in Virginia, North Carolina, South Carolina, and Georgia. It is definitely a threat to the successful cultivation of the mimosa, one of the most popular and widely planted ornamentals in the South. The symptoms and causal organism have been described in a Departmental Circular. The past year's work was confined to testing the resistance of seedlings grown from seed collected from 44 localities scattered from Washington, D. C., to the Gulf of Mexico. The aim of the work was to try to discover resistant lines, or individuals, which could later be propagated to supply resistant stock. In most cases 10 to 15 seedlings from a given parent were used, but in a few cases less were available. Five months after inoculation all of the seedlings from 25 of the localities were dead. Some trees from several other localities were still alive, and in one group of 10 seedlings 7 were still alive.

Plantation Diseases

A broad study of diseases affecting plantations of southern pines was started this year with the establishment of plots of 50 trees each in 19 localities in 7 plantations in North Carolina. Additional plots will be added from time to time until a substantial sample of plantations of shortleaf, loblolly, and slash pine in the middle Atlantic states is under systematic observation.

CCC Service

The CCC pathologist gave lectures and demonstrations at 28 state, national forest, and S.C.S. CCC Camps. He also put in 4 demonstration field plots on methods of treating sprout oak stands for the S.C.S., and supervised the eradication of *Nectria* cankers over 200 acres in western Maryland.

CONTROLLING FOREST INSECTS*

Generally speaking, fences about fields in the southeastern states are uncommon. The primary reason for this is not as puzzling as it first seems. Although a great timber-producing section, the woods produced are predominantly non-durable and unsatisfactory for use as fence posts. But southern pine trees can be effectively impregnated with inexpensive chemicals before being cut into posts. Long service tests show conclusively that these chemically treated posts give ten times the length of service that could be expected of untreated posts.

Cheap metallic salts, such as zinc chloride and copper sulphate, can be introduced into healthy pines at any time of the year, by one of several methods requiring no special tools or equipment. A tree up to 6 inches in diameter can be treated by severing it from the stump, lodging its crown in a neighboring tree and then placing the butt of the stem in a bucket of chemical solution. Both small and large trees can be treated by felling them and capping the butt ends with tight-fitting automobile inner tubes into which the chemical solutions are poured. Also, a small or a large tree can be treated, without felling, by introducing the chemical into a horizontal saw or ax girdle made around the base of the tree stem. In this latter procedure the chemical is held in a collar-like container made of a piece of automobile tire inner tube fastened tightly around the tree stem.

Regardless of the method of treatment used, a very satisfactory concentration has been found to consist of three-fourths pound of either zinc chloride or copper sulphate to approximately one-half gallon of water for each cubic foot of sapwood in the tree stem. Ordinarily the solution will be entirely absorbed by the tree within 12 hours. It usually takes about 2 weeks before the chemical is completely distributed throughout the sapwood. Excluding labor costs, a 5-inch tree which will yield from 4 to 5 posts can be treated at a cost of between 10 and 20 cents per tree.

Additional tests made during the year indicate that with larger trees similar chemicals and injecting procedures are not as effective in preventing insect development and stain penetration. However, other hitherto untried salts, one an organic compound, tested this year, are already providing encouraging results. They suggest uses of the chemicals for bark beetle brood control in infested trees, as well as for wood preservation.

The investigations of wood preservatives are directly tied into studies of termite control. Large series of poles from trees

*The Station cooperates in these studies by the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

treated with chemicals were set out in Maryland, South Carolina and Mississippi during the year for service tests against termites.

Numerous inspections of commercial treatments of termite infested buildings have revealed the necessity for more rigid regulations governing the commercial practices of controlling termites. The use of poisons, both in the soil and injected into woodwork in place, by many commercial concerns is, in the majority of instances, not sufficient to control termites already in the structure or to protect them from termite invasions.

Cooperative studies with a company producing inexpensive chemical impregnated fibre-board made of southern pines have been in progress during the year. Service tests in soil heavily populated with subterranean termites on the Coastal Plain of South Carolina are already giving results that should be of tremendous value to the consuming public.

FOREST INFLUENCES

New Technic Developed for Watershed Management Research.

A major accomplishment in 1940 was the completion of a method of "standardizing" experimental watersheds so that each watershed serves as its own control in studying the effect of different kinds of land use upon streamflow and water yields. The new method makes it possible to follow the cumulative effects of changing from one land use to another on the same drainage area, and even to return to the original vegetative cover condition or land use practice after studying other conditions for a period of time.

This procedure, first proposed and adopted by the Appalachian Station in 1933-4, is simply the determination of how a stream fluctuates (from season to season and for the widely varying conditions to be expected over a period of years) under an existing form of land use, prior to changing to another form of land use. A standard of performance for stream behavior is thus set up, from which the effects of changing to another form of land use can readily be determined by comparing the stream behavior records before and after the change.

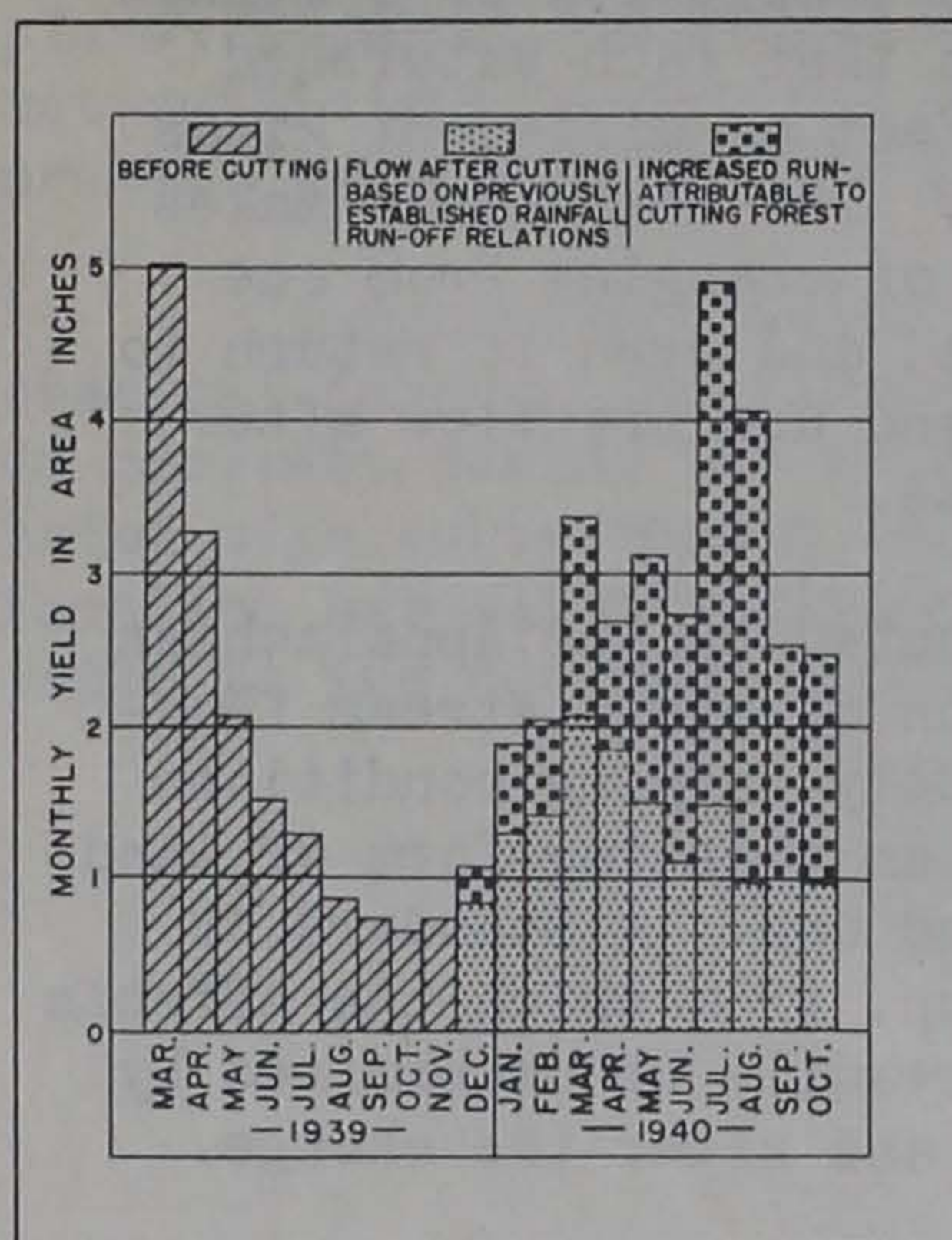
The standardization method for watershed studies has advantages over any method of using duplicate drainages for comparing land use practices because it is difficult to obtain two drainages exactly alike in geology, topography and stream pattern -- factors that are all essential to stream behavior. By standardizing an individual watershed it becomes its own control throughout the experiment.

To test the scientific soundness of the standardizing process required the analysis of a huge mass of continuous run-off and precipitation records from 30 drainage areas, each covering a period of from 4 to 6 years -- equivalent to 180 years of continuous record from a single stream. Now that the method has been verified and standardization completed for a number of drainage areas, it is possible to proceed with modifications of watershed cover conditions with confidence that the resultant effects upon streamflow and water yield can be correctly interpreted in terms of practical land use management problems.

Development of a method of watershed standardization constitutes definite progress in drainage area studies. It provides a new method of conducting drainage area studies over a wider range of land use practices and under conditions which previously have been considered impossible. Further studies are now in progress to determine the minimum time required for standardization of small drainages and for simplifying the technic of collecting and analyzing field data.

Cutting the Forest Changes the Water Yield

The Station's newly devised method of "standardizing" watersheds has been put to use in measuring the effects on streamflow of removing a heavy forest cover from a 40-acre experimental drainage area on the Coweeta Experimental Forest.



For this watershed the standardization period was 4 years. On the accompanying graph the monthly water yield before and after cutting is shown in area inches. For the 12 months following cutting the yield is expressed as the expected yield based on past records of rainfall and run-off relationships, and as the actual yield that may be attributed to removal of the forest. Now that the transpiration draft has been so largely reduced the water economy of this area is completely changed. The water which formerly was lost through transpiration has gone into ground water storage and the seepage from this storage accounts for the increased yield.

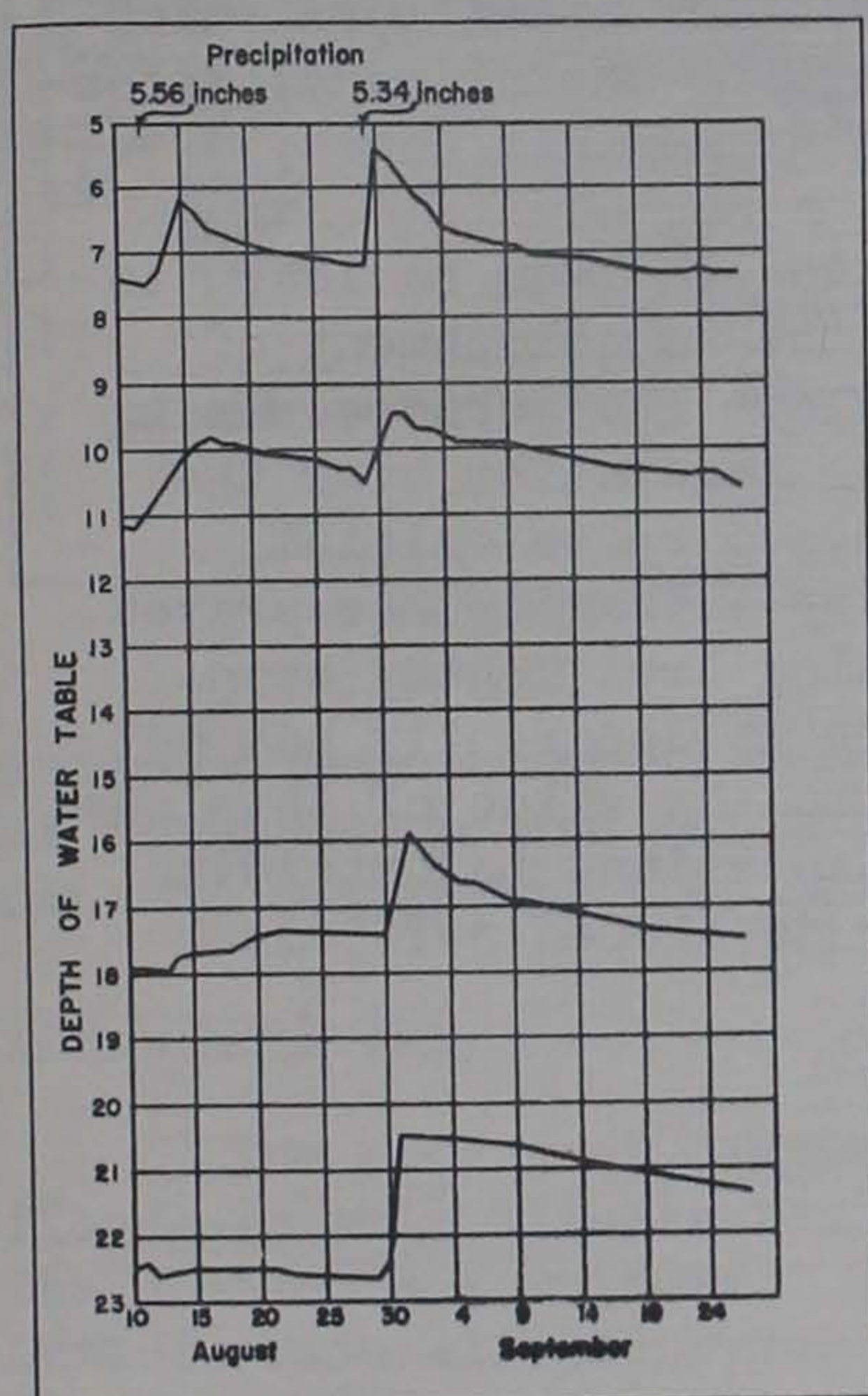
Moreover, in November 1940 at the beginning of winter rains when ground water storage usually begins, the storage opportunity for this area is much less than in previous years before removal of the forest cover. The conditions thus are similar to those favoring flood run-off in spring months when the maximum amount of storage water is usually present.

Such facts, which the watershed studies are bringing to light, have a very practical significance for forest land administrators. For example, the possibility of increasing summer water yields by reducing transpiration has application in handling municipal watersheds, where expensive developments justify special procedures to insure a maximum of uniform streamflow. On the other hand, administrators of large tracts of headwater land can be shown quantitatively the danger of creating potential flood conditions by extremely heavy cutting carried out simultaneously over extensive areas. The specific results obtained on the Coweeta Experimental Forest are directly applicable only to areas of high rainfall, but the principles evolved have widespread application.

Well Records Aid Land Use Studies

For several years the Station has been studying ground water movements in connection with the effects of different kinds of land use upon the water resources. These movements are measured as variations in the height of the water table observed in a series of experimental wells. Records of water table elevation are plotted daily. They serve as guides to favorable conditions for carrying out field operations in all watershed studies, as a supplement to transpiration studies, and as a basis for analyzing compound storm hydrographs.

That records of the water table in experimental wells serve as an index of soil moisture relationships was strikingly shown in August 1940 by a series of comparable wells so located with regard to topography that the depth to the water surface differed from 7 to 22 feet. A rain of 5.56 inches on August 12 produced a sharp rise in the wells showing normally high water tables (see graph), indicating that field moisture capacity had been exceeded within the limited unsaturated zone. Deeper water tables in wells with deeper unsaturated zones were less influenced than where the water table was nearer the surface.



But when another rainstorm of 5.34 inches occurred on August 29, the water tables in all the wells rose sharply, indicating that even at the lower depths the water requirements to bring the soil to field capacity within the zone of aeration had already been met (during the previous storm), and only a small additional quantity of water was needed to bring the soil to saturation. This reduced capacity for underground storage explains why one rainstorm might produce no flood, while a closely following storm, even though of much less intensity, might result in a severe flood.

These results suggest that wells may prove serviceable for other experimental purposes, as for example, in obtaining water table data as an integral part of silvicultural research. For this purpose wells would be particularly serviceable in relatively level areas or in valley bottoms where water tables are usually close to the surface. Growth and survival of plantations may have a direct relationship to soil moisture in the southeastern states where the water table is so close to the surface that measurements can be made easily.

Roadbank Naturalization Findings Widely Applied

More than a thousand miles (perhaps 2 or 3 thousand miles) of heretofore unattractive and eroding roadbanks have now been naturalized through the practical application of methods developed experimentally by the Appalachian Station. The national forests, state highway departments, and other public agencies are now applying these methods to extensive roadside development projects. During 1940 the Station's activities in the project were chiefly the reexamination and analysis for publication of over 200 experimental plots, but assistance in practical application of the method occupied considerable additional time.

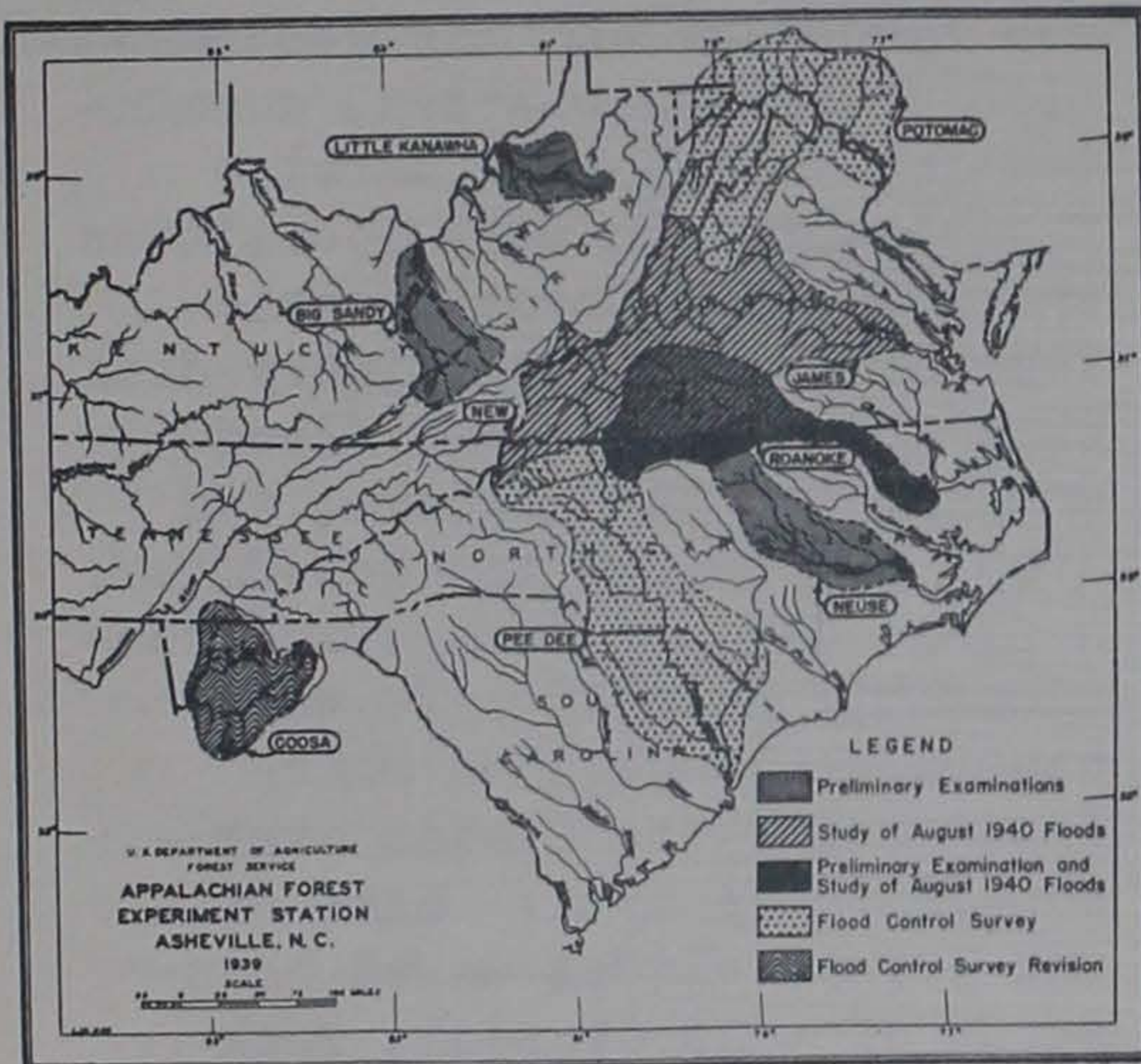
The roadbank naturalization studies, which were begun by the Station in 1934, have covered investigations of cost and technique under a wide range of conditions. It had previously been thought that naturalized roadbanks could be obtained only at great expense. Investigations showed that good results can be obtained by relatively simple and inexpensive methods. The extensive demonstrations which followed these studies have successfully overcome the original incorrect impressions by giving excellent results at nominal costs.

Further studies were made by the Station in 1940 to learn to what extent commercial fertilizers will aid the establishment of vegetation on unusually sterile roadbank soils. The purpose was to stimulate root development to aid in carrying vegetation over the critical period of the first winter. For this purpose calcium metaphosphate produced by the Tennessee Valley Authority has proved effective, particularly when used with mulching treatments; even when applied at the rate of 400 lbs. per acre it apparently has not injured young plants. Final conclusions as to the value of this new fertilizer for this work must await later inspections to determine whether or not the seedlings fertilized have developed sufficient root systems to withstand frost heaving.

FLOOD CONTROL SURVEYS

Surveys Now in Progress on 7 Watersheds

In 1940 the Station participated in flood control studies on 7 watersheds. (See map.) Detailed flood control survey studies were made on the Potomac, Pee Dee, and Coosa watersheds. Preliminary examinations and reports were made of the Big Sandy, Little Kanawha, Roanoke, and Neuse watersheds.



FLOOD CONTROL ACTIVITIES DURING 1940

Although the aggregate area of these watersheds -- 34,000,000 acres -- is larger than the combined areas of Massachusetts, Vermont, and Maryland, their flood problems and related land use problems are generally representative of a region more than three times as great.

Within the 7 watersheds the direct damage from floods is roughly estimated at \$3,000,000 annually; but the same misuses

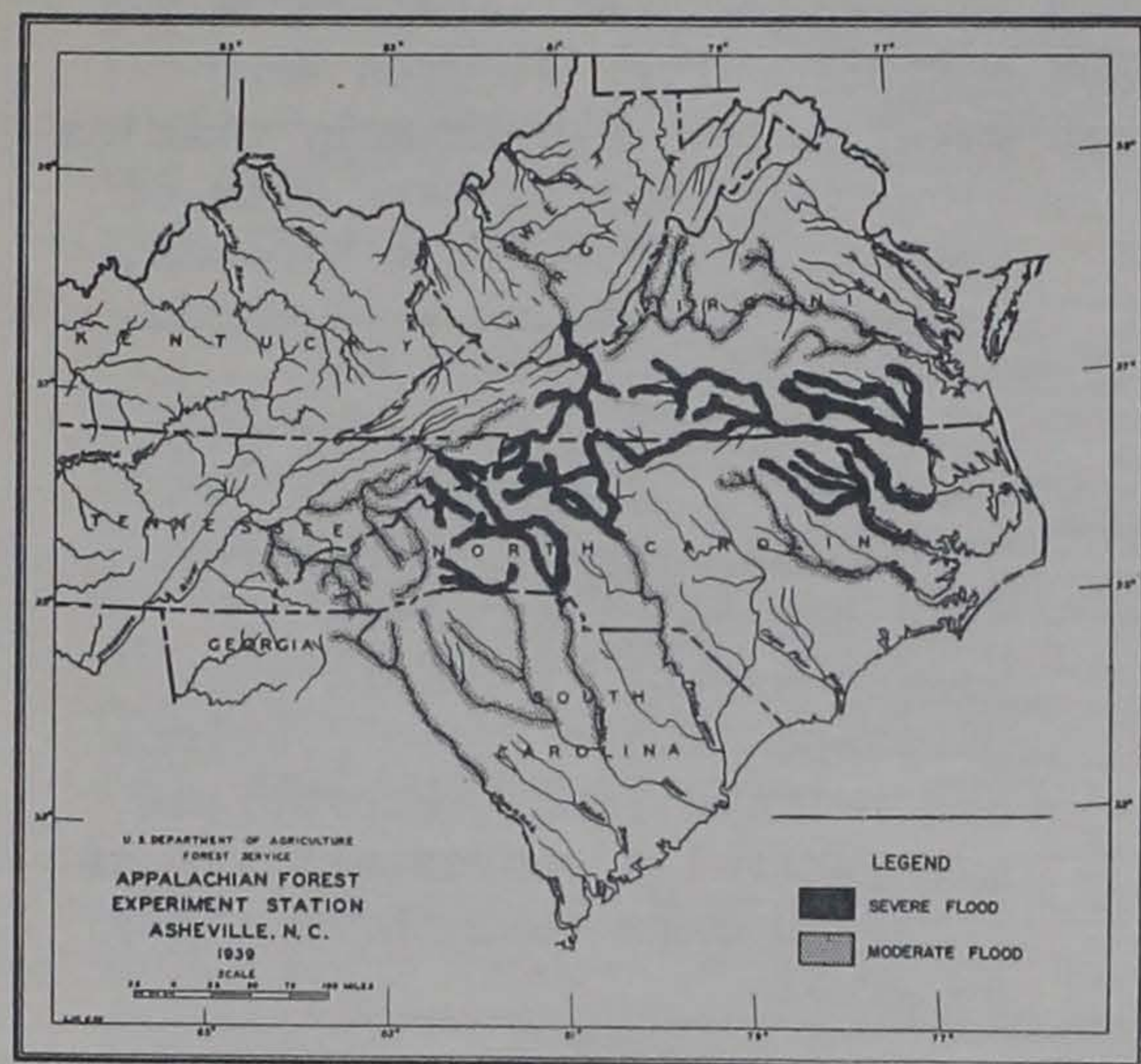
and poor management of forest and farm lands that are contributing causes of flood damage are probably also responsible for even greater losses to natural resources, land productivity, and income.

The August 1940 Floods

The extent of damages and human suffering caused by extreme floods is well illustrated by the August 1940 floods occurring within the Station's territory. These floods were the result of heavy and intense rainfall occurring on August 11-17 and August 29-30.

The first storm resulted from a hurricane that produced 12 to 17 inches of rainfall in 4 days, 6 to 12 inches in 2 days, and as much as 2 inches in an hour for areas in northern Georgia, western North and South Carolina, eastern Tennessee, and southern Virginia. The resulting floods on the Watuaga, New, Tar, Chowan, and Roanoke Rivers and on the upper reaches of the Santee and Pee Dee Rivers appear to have exceeded all previously recorded floods. The Roanoke River whose entire watershed was within the zone of heavy rainfall, reached a crest at Weldon, North Carolina, of 58 feet, exceeding by 6.4 feet that of 1877. Floods were also severe but probably not the maximum of record on the French Broad, Little Tennessee, and Neuse Rivers and on the upper reaches of the James and Savannah Rivers.

These floods generally were flashy and of short duration. In the sections worst affected, streams draining 50 to 100 square miles rose 25 feet or more in a few hours and receded at the same rapid rate. Tentative figures indicate a peak flow for Elk Creek, a mountain tributary of the Yadkin River draining parts of Watauga and Wilkes Counties, North Carolina, of about 1,000 c.f.s. per square mile.



APPROXIMATE EXTENT OF MID-AUGUST 1940 FLOODS

There was untold human suffering over much of the flooded area, caused by the loss of homes, buildings, crops and livestock and the destruction of transportation, communication, and public service facilities. In many localities there was also considerable loss of life. Preliminary data show about \$5,000,000 flood damages for the Roanoke, and about \$2,500,000 for New River. A great deal of damage and considerable loss of life was caused by landslides which accompanied the floods over a considerable area. Some of the larger slides moved thousands of tons of soil, rock

and debris from the mountain slopes into the valleys, covering up or scouring a large proportion of the limited productive bottomland and causing widespread damage to buildings and other property.

One aspect of these floods which is particularly significant is their effect upon the depth and configuration of the stream channels. Channels which for scores of years had been in the process of filling by eroded materials were greatly deepened in places of high velocity and their banks extended by from 3 to 30 feet or more. These changes took place mostly on the upper tributaries, whose channels now have many times their pre-flood capacities. In sections of lower velocities, usually farther down stream, the channels frequently have less capacity now owing to the deposition of flood transported material from above.

The second storm occurred on August 29 and 30 over a rather restricted area in western North Carolina, affecting chiefly the headwaters of the Pigeon, French Broad, and Little Tennessee Rivers. At the summit of Mt. Mitchell the two-day rainfall was 12.19 inches, of which 9.83 inches fell in one day. At other points from 4 to 7 inches were recorded in one day; apparently elevation and aspect strongly influenced the quantity of rainfall. The resulting flood stages on the streams affected were in general higher than those caused by the earlier storm, particularly on the Tuckasegee, a tributary of the Little Tennessee River, and on the Pigeon River and Hominy Creek, both of which are tributaries of the French Broad River.

Storms and floods such as these are of course very infrequent, and their occurrence at this time, during the course of flood control studies, is enlightening because it has made available information not hitherto recorded for such extreme conditions and not likely to be experienced again in a lifetime. The unprecedented opportunity thus presented for obtaining data which will be fundamentally useful to many later flood control and hydrologic studies is being utilized by the Station. In cooperation with the War Department, the Geological Survey, the Weather Bureau, and with other bureaus of the Department of Agriculture, rainfall and run-off records are being assembled and computed, peak flows computed for many ungaged streams, times of flood peak occurrence determined, high water marks located, and estimates of flood damage compiled.

RANGE RESEARCH

Station Begins Grazing Research

A new activity -- the study of forest grazing in relation to beef cattle production -- was started by the Station in November 1940. This is a cooperative project of the Forest Service, Bureau of Animal Industry and the Agricultural Experiment Stations of North Carolina and Georgia. For the present, work is concentrated on forest lands in the Coastal Plain of North Carolina and Georgia.

A New-Old Range Country

When most people think of the range cattle industry they think of the Far West. But there has been open range grazing in the southeastern states since the days of the Spanish conquistadores -- never a very large industry if judged by western standards -- never a serious market competitor, even though two-thirds of U. S. meat is eaten east of the Mississippi River -- overshadowed always as a cash crop by cotton and tobacco. The southeast has seen periodic mild booms in cattle raising but probably never so pronounced or so solid a swing toward beef production as is occurring now. In one North Carolina county just surveyed by the Station the increase in the number of cattle was from 600 to over 3,000 in the last two years; in another county it was from 80 to 750, and similar increases are noted in other counties. In Georgia, according to Extension Service figures, farmers bought through that Service three times as many better-grade heifers and twice as many better-grade bulls in 1939 as were purchased in 1938.

Beef Cattle Producer Faced with Many Problems

Many of the southeastern farmers now turning to cattle production lack experience in this business. They are beginning to raise cattle because of low prices received for other farm crops, because of loss of markets for cotton, tobacco and other crops, because of the increasing cost and scarcity of farm labor, because of increasing acreages in soil-conserving crops such as lespedeza which yield cattle feed, because on low-quality land few cultivated crops except cotton and tobacco yield enough to pay for the large amount of fertilizer required, and because prices now paid for beef seem tremendously attractive to them.

Newcomers to this business are likely to plunge too fast and too far. Some already are in difficulty. There is no background of fact to guide the open-range (generally forest land) grazing now commonly practiced. No one knows how to estimate the grazing capacity

of these ranges; every green plant is thought to be potential animal food and, as a consequence, cattle often lose weight in the midst of apparent plenty. There is very little information for the newcomer -- or the old-timer, for that matter -- on hardiest, most profitable breeds and grades of cattle; on age at which to breed; on costs and returns of supplemental feeding; on best age to sell young stock; on grazing methods which will keep range lands continuously productive. Most past research in this area has dealt with feeding experiments, with the better types of cattle, and with improved pastures; whereas actual practice is to run grade cattle largely or entirely on open ranges without supplemental feeding.

Some farmers think that yearly burning of range lands gives better grazing and more meat per acre; others believe that such practices produce watery, low-quality meat. Many consider that grazing is harmful to tree growth, whereas others think grazing helps tree growth; yet each of these groups wants to raise both trees and cattle on the same area. These are just a few of the questions that will have to be answered for the farmer. The alternative to research is expensive trial and error experience which few farmers in this area dare risk.

Foresters are Interested

Foresters are deeply concerned in the southeastern beef cattle industry for nearly all of this grazing is on forest land. In a region where 99 percent of all forest fires are man-caused it does little good to spend money on fire prevention campaigns if (as surveys are showing) forests are burned because of the belief that burning improves the pasturage. In a region geared largely to the utilization of pine timber it is possible that forest grazing may help to stem the tide of a hardwood invasion of pine stands which many foresters now are noting. There is some observational evidence that moderate woodland grazing may tend to reduce the fire hazard, through consumption of grasses and weeds, by as much as one-half.

In any event, foresters hold no brief for wood production as the only form of land use. The object of grazing research at this Station is to find how to make the most money from forest land; it may be through grazing alone or through tree growth alone or by some combination of these two land uses. In this work foresters will draw on a 33-year background of experience with forest land grazing in the West and much of the knowledge gained there can be modified for application in the Southeast. Results after two months of work are sufficiently encouraging to suggest that considerable actual accomplishment can be described in the next annual report.

SUMMARY OF PLANS FOR 1941

Forest Management Research

- (1) Complete analysis and publish results of study of effects of cutting method upon costs of harvesting loblolly pine pulpwood. Complete study of accelerated growth in mountain hardwood and loblolly pine types and prepare results for publication. Compile in one report all current available data on development of epicormic sprouts. Revise and publish manuscript on hardwood invasion of Piedmont pine stands. Prepare for publication a paper coordinating recent studies on loblolly pine silviculture.
- (2) Complete analyses of records from stand improvement experiments and publish reports on: (a) Early response of mountain hardwoods to weeding, (b) Influence of various degrees of green pruning on growth of white pine, and (c) Response of white pine understories to liberation cuttings in hardwood overstory.
- (3) Maintain seed production studies. Publish results of a 5-year study of seeding characteristics of 5 important Appalachian oaks. Assist Lake States Station in preparation of a comprehensive seed manual. Begin problem analysis to determine studies needed in Silvics.
- (4) Prepare report on results of experiments to determine the species most suitable for various planting sites in the Appalachian Valley. Revise and publish report on variations in site factors important to plantation success in the Appalachian Valley. Assemble into one report all available information on the underplanting of white pine in laurel and rhododendron thickets. A small part of the establishment work on the spruce regeneration study was not finished last year and will be completed in the spring of 1941; routine release treatments scheduled for this study will be continued. Preliminary results from the spruce planting study will be published.
- (5) Routine examinations will be made on the large-scale tests of the more successful direct seeding methods. Prepare paper on direct seeding experiments with 3 southern pines, including some cost comparisons of planting versus direct seeding.
- (6) Publish results of the one-parent heredity study of loblolly pine at Bonneau, South Carolina. This will close out the study since all plantations have been destroyed by the Santee-Cooper hydroelectric project. Reexamine 1936 black locust seed source tests to see if anything can be salvaged following severe deer browsing. If not, close study.

- (7) Complete final checks of form class volume tables for 16 species and release these in a technical note. Publish tables for estimation of cordwood volume in oak tops.
- (8) Complete 5th year examination of permanent growth plots by spring of 1941 and begin analysis for development of growth prediction methods.
- (9) Publish nearly completed paper describing the construction of circular slide rules for formulae used in forestry. Complete and publish paper on the tests for curvilinearity in multiple regressions.
- (10) Complete the following reports for publication: (a) Theories of visibility and their application in fire detection; (b) Causes of atmospheric haze; (c) The visual perception of small objects. Analyze fire reports for the past 3 years to revise fuel type classification and determine rate of spread and resistance to control. Issue results of these analyses as technical note. Complete all tests of the "haze cutter", manufacture several of them, and test their practical value for increasing the visual range of fire lookouts.
- (11) Issue a technical note presenting the fire damage appraisal table and directions for its application. Complete and publish results of study on effects of basal wounding on trees. Continue scheduled reexaminations of permanent experiments in fire effects.
- (12) Complete and publish the results of the following fundamental studies on fire behavior: (a) Solar radiation and forest fire danger; (b) Terrestrial radiation and forest fuel moisture; (c) Possible cause of large crown fires in coniferous forests. Review records thus far obtained in study of fire danger rating as influenced by aspect and altitude of stations. Prepare results for use if the review shows this to be justified.

Forest Influences Research

- (1) Proceed with changes of cover conditions on standardized watersheds according to plans approved by the Influences Conference, April 1940.
- (2) Continue water table and soil moisture observations to assist in computing monthly evaporation and transpiration factors for drainage area studies.
- (3) Determine changes in the local climate of drainages being used for different land use practices.

- (4) Observe effects of fertilizer tests on roadbank naturalization tests. Make further observation of vegetation establishment on national forest and state highways.

Forest Survey

- (1) Compute tables of area and volume for all Virginia units.
- (2) Make growth computations for 1939 in North Carolina and South Carolina. Revise growth computation procedure for Virginia and complete computations for at least the Coastal Plain and Piedmont units.
- (3) Make complete mill-to-mill canvass of primary wood-using industries of Virginia and cooperate with census in editing questionnaires on 1940 census of lumber production and field check delinquent mills in these states.
- (4) Complete state reports for South Carolina and North Carolina and as many unit reports for Virginia as possible.

Range Research

- (1) Complete the forest grazing and beef cattle survey now in progress in the Coastal Plain area of North Carolina.
- (2) Make a survey of forest grazing and beef cattle problems, similar to the one being made in North Carolina, in the Coastal Plain area of Georgia.
- (3) Compile separately and analyze survey data collected in the Coastal Plain area of North Carolina and Georgia.
- (4) Based on the analysis of the survey data collected in North Carolina and Georgia, draw up working plans for intensive studies in each of these states.
- (5) Continue with exploratory or pilot studies now in progress until working plans are complete.

Flood Control Surveys

- (1) Assist in the completion of the preliminary examination report on the Neuse River watershed.
- (2) Complete advance study of August 1940 floods.

- (3) Prepare survey work outline for the Roanoke River watershed.
- (4) Complete flood control survey on Potomac River watershed.
- (5) Assist in completion of flood control survey on Pee Dee River watershed.
- (6) Assist in completion of revision of Coosa River watershed flood control survey report.

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BY
MEMBERS OF THE STAFF, INCLUDING COOPERATORS

January 1, 1940 - December 31, 1940

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The Appalachian fuel moisture scale. Jour. Forestry 38: 493-495.

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An eye test for lookout men. Fire Control Notes 4: 123-128. July.

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The forest resources and industries of North Carolina. Southern Lumberman, December 15, p. 179.

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Common tree names made uncommon, or the taxonomist works on the common name. Service Bul., August 19.

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South. Econ. Jour. 6: 440-448.

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Mating habits of Scolytus multistriatus and the dissemination
of Ceratostomella ulmi. Jour. Econ. Ent. 33: 818.

JEMISON, GEORGE M.

Gauging the fire period. Outdoor Life, April.

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The natural establishment of pine in abandoned fields in the
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Log, April.

Early planting experiments in the spruce-fir type of the southern
Appalachians. Jour. Forestry 38: 651-654.

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Vegetative competition as related to plantation success in the
southern Appalachian spruce type. Jour. Forestry 38: 68-69.

MOSES, C. S. and HOFFMANN, C. H.

Isolation of Ceratostomella ulmi from Scolytus multistriatus adults
stored at different temperatures. Phytopath. 30: 701-702.

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Vigorous young yellowpoplar trees can recover from injury by
Nectria cankers. Jour. Forestry 38: 587-588.

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BARRETT, LEONARD I.

Observations on requirements for restocking cutover loblolly and shortleaf pine stands. Tech. Note 42,--October 30.

BUELL, J. H.

Some results of a study of the crop tree method of timber stand improvement. Tech. Note 41, April 12.

HEPTING, GEORGE H.

Early removal of surplus oak sprouts desirable to reduce butt rot. Tech. Note 40, March 25.

LAXTON, JOSEPHINE.

Publications by members of the staff, including cooperators, January 1, 1937 - December 31, 1939. Tech. Note 39, March 25.

Forest Survey Releases

CRUIKSHANK, J. W.

Forest resources of the southern coastal plain of North Carolina. Forest Survey Release 4, April 1.

Forest resources of the northern coastal plain of North Carolina. Forest Survey Release 5, June 15.

Forest resources of the Piedmont region of North Carolina. Forest Survey Release 6, November 15.

Flood Control Reports

Report on preliminary examination of Big Sandy River and tributaries for flood control. May 15.

Report on preliminary examination of Little Kanawha River and tributaries for flood control. August 15.

January 1, 1941

PROJECT STATUS SHEET

Harvest Cuttings

Field division: Forest management research.

Work project: Silviculture.

Line project: Harvest cuttings.

Purpose: To determine the methods of harvesting merchantable products that will provide the greatest sustained income. (To eventually cover all forest types in Station's territory.)

Review of past work: Examination of cutover land and establishment of controlled experiments have shown that although Appalachian hardwood types can be perpetuated either by even-aged or all-aged methods, the latter is more feasible for all types except those containing high proportions of hemlock. Stands of hemlock left after partial cutting frequently show high mortality. Clear-cutting of hemlock by natural groups is recommended. Partial cutting, in mature loblolly pine sawtimber particularly, frequently is followed by heavy mortality in residual stands. Attempts to produce many-aged stands of southern pine through partial cutting is often inimical to establishment of pine reproduction and favorable to invasion by hardwoods.

Accomplishment during past year: A series of 6 treatments testing different methods of harvesting pulpwood stands of loblolly pine was established in each of 5 localities. These were designed to determine whether it is more profitable to raise pulpwood on successive short rotations, or to raise higher valued products on long rotations with pulpwood as an intermediate crop. Analysis almost completed on the phase dealing with costs of the initial harvest. The need for more data curtailed the analysis on the reduction of clear length due to epicormic branches. Submitted for publication a manuscript dealing with the growth and mortality of loblolly pine during 10 years following partial cutting and a report of an analysis of cutover areas in the Appalachian hardwood types.

Plans for next year: Most of the year will be devoted to the preparation of plans for the intensive management of 2 experimental forests. Analysis will be continued and manuscripts prepared for publication on: costs of harvesting pulpwood, development of epicormic branches, and acceleration of growth following partial cutting.

Date of completion: Project as a whole is continuous. Management of the experimental forests is continuous and will be expanded to embrace experimental forests in other types. Short-time studies designed to supplement the management of the experimental areas will be terminated upon publication of the results.

Assignment: L. E. Chaiken, A. A. Downs.

PROJECT STATUS SHEET

Stand Improvement

Field division: Forest management research.

Work project: Silviculture.

Line project: Stand improvement.

Purpose: To develop standards for ultimately profitable improvement measures that will maintain or improve the growth rate and stem and stand quality of juvenile stands and run-down forests of older age classes.

Review of past work: Experiments have been established to test the efficiency of different methods of weeding 3 of the most valuable hardwood species. These experiments are now from 4 to 8 years old and will soon yield definite results. One of the most pressing problems in stand improvement is how to rehabilitate the deteriorating stands so prevalent in the southern Appalachian hardwood types; plots testing 5 treatments were established 10 years ago. A 9-year old experiment is in progress on the liberation of white pine from a decadent and unmerchantable overstory. A study in the pruning of white pine has been in progress for 5 years. A number of thinning experiments, established from 5 to 20 years ago, are testing the procedures and results of thinning white, shortleaf, and loblolly pines, sugar maple, yellowpoplar, and mixed oaks.

Accomplishments during past year: Considerable time during the year was spent remeasuring sample plots. Manuscripts for publication were submitted on: results of timber stand improvement work done by the C.C.C.; sprouting of dogwood; and a paper on results of thinning planted white pine on the Biltmore Estate is nearly complete.

Plans for next year: Many of the experiments in stand improvement now are beginning to show definite results. Analyses will be carried on and manuscripts prepared for: early responses to weedings, growth of pruned white pine, and liberation of white pine.

Date of completion: Project as a whole is continuous. Experiments in weedings, prunings, and thinnings have been aimed primarily toward the development and perfection of methods. This phase is rapidly coming to a close and further work will be pointed toward investigation of costs and returns of stand improvement.

Assignment: A. A. Downs, E. H. Frothingham.

January 1, 1941

PROJECT STATUS SHEET

Silvics

Field division: Forest management research.

Work project: Silviculture.

Line project: Silvics.

Purpose: To determine basic factors essential to establishment and early survival of important timber species; to detect and report ecological trends important in forest management.

Review of past work: In 1935 records were started on the production of acorns by 210 trees of the following species of oak: white, scarlet, black, chestnut, and northern red. In 1936 a study was established to measure the amount of seed disseminated in a clear-cut strip adjacent to a mature stand of loblolly pine. A bumper crop of seed was produced during the fall of 1936 by both the oaks and the pine. Since then the annual crops have been only poor or fair.

Ecological studies in the Piedmont region have shown aggressive invasion of hardwoods into pure pine stands, creating conditions inimical to maintenance of high proportions of pine in future stands.

Accomplishments during past year: Measurements of oak and pine seed production were continued. The clear-cut strip was widened during the early spring and the seed traps were redistributed over the larger area. A small supplementary study was started to determine the viability of insect-damaged acorns.

A technical note was prepared summarizing the results of experiments and observations on the adequacy and efficiency of seed trees of loblolly and shortleaf pines.

Plans for next year: Maintenance and reexamination of existing seed production studies. Two-months assignment to Lake States Station to assist in preparation of seed manual. Preparation of problem analyses for new work in Silvics. Results of 5 years' observation of acorn production will be published.

Date of completion: Project is continuous. Present experiments of seed production may soon be discontinued and re-designed to embrace other species and determination of differential between amount of seed produced and seedling establishment.

Assignment: W. E. McQuilkin.

January 1, 1941

PROJECT STATUS SHEET

Planting

Field division: Forest management research.

Work project: Regeneration.

Line project: Planting.

Purpose: To determine the best planting and direct seeding methods and the best species adapted to the various sub-regions within the Station's territory.

Review of past work: First exploratory planting experiments were begun in 1923 in the cutover and burned spruce type of the mountain region. Large numbers of coniferous species, including exotics, were established in this type. The last examination was made in 1939.

Description and classification of plantations established on the Biltmore Estate in Buncombe County, North Carolina, were completed and published as U. S. Dept. Agric. Misc. Pub. No. 61, 1930.

In 1938, eight large-scale planting experiments dealing with problems of abandoned lands in the Appalachian Valley were started in cooperation with the Tennessee Valley Authority. Planting of the 700 plots was completed and first-year examination made.

Reconnaissance and analysis of the planting problems in the red spruce type were completed and a report prepared. A working plan was written and experiments laid out on the ground in 1939.

An intensive study of various methods of direct seeding of spots was begun in the Piedmont region. Examinations were carried out through the summer and fall of 1939.

A number of experiments both in North Carolina and Georgia have been established to test methods of planting white pine in laurel thickets.

Additional small studies started and still continuing are yellowpoplar interplantings, oriental chestnut, hybrid poplar, and white pine plantings in northern Georgia.

A study completed and published in 1939 helped point the way to a now general substitution of random or mechanically spaced milacre plots for the staked row system of plantation examination.

Accomplishments during past year: Analyses of first-year examination results of the cooperative planting experiments in the Appalachian Valley were completed and a manuscript prepared and accepted for publication. The third-year examination was made on plots of that age and a set of planting specifications drawn up based on the results. Using these specifications, a planting survey of a 2,800-acre tract, including 720 acres of plantable land was made. This area will be planted by TVA.

Planting and seeding of over half of the experimental plots in the spruce type was completed. Preliminary survey of first-year results indicates that certain treatments may be effective in

(Over)

regenerating difficult planting areas in the spruce type. Direct seeding has shown considerable promise. Results of the 1923 experiments testing species suitable for the spruce type were published.

First results from direct seeding of pine in the Piedmont showed that some treatments gave successful establishment of seedlings and the best of these have been again tested in a corroborative series of seedings. An additional seeding of about 13 acres has been made for the purpose of comparing costs and results of direct seeding with planting.

Reexamination showed that laurel and rhododendron thickets can be successfully replaced by white pine if the planting is preceded by partial cutting of the dense overstory. Grubbing of the roots showed no advantage over cutting only.

Informal examinations were made on oriental chestnuts and hybrid poplar plots on the Toccoa Experimental Forest and white pine plots in northern Georgia.

Plans for next year: Examination for third-year survival and growth of the Appalachian Valley experiments will be made and a publication and technical note prepared. Planting of over 100 "pilot plant" or demonstration plantations will be completed. A publication on some of the more fundamental site characteristics in the Appalachian Valley will be finished.

Establishment of the spruce regeneration study will be completed and treatments continued. A technical note on the earlier and some of the current phases of this work will be prepared.

Routine examinations will be made on all 3 series of the Piedmont direct seeding experiment and a short article for publication and a technical note covering results to date will be prepared.

A short publication and a technical note will be prepared on the planting of laurel thickets to white pine.

Date of completion: Project as a whole is continuous. Complete data on third-year survival and growth of the Appalachian Valley plots will be available in 1942 and for the spruce regeneration plots in 1943. Major objectives of the Piedmont direct seeding study will be completed by 1942.

Assignment: L. S. Minckler, W. E. McQuilkin.

January 1, 1941

PROJECT STATUS SHEET

Seed Studies

Field division: Forest management research.

Work project: Regeneration.

Line project: Seed studies.

Purpose: To determine the importance of seed source in artificial regeneration.

Review of past work: An extensive experiment to determine the growth of loblolly pine seedlings grown from seed produced by parent trees of various characteristics was established in 1936 at Bonneau, South Carolina, on the Francis Marion National Forest. Although some real differences have already become apparent in growth rates of the various lots of seedlings, this experiment cannot be concluded because the trees have been cut to make way for the Cooper River hydro-electric dam.

Tests of the importance of geographical location in the growth and survival of black locust were established in 1936 on the Bent Creek Experimental Forest but few, if any, results will be obtained because of severe browsing by deer.

Accomplishments during past year: Data from the 1939 examination of the Bonneau plots were analyzed and summarized.

Plans for next year: Publication of the final results from the Bonneau plantations will be made. Black locust seed source study plots will be examined and probably abandoned due to deer browsing and heavy mortality. Plans will be made for future seed studies.

Date of completion: Project as a whole is continuous. Loblolly pine experiments at Bonneau will be completed in 1941.

Assignment: L. S. Minckler.

January 1, 1941

PROJECT STATUS SHEET

Stand Studies

Field division: Forest management research.

Work project: Mensuration.

Line project: Stand studies.

Purpose: To determine growth, yield and mortality of forest stands representing the important timber types of the Appalachian Station territory and to develop improved methods of growth, yield and mortality predictions.

Review of past work: Field data for non-normal yield tables for loblolly, shortleaf and Virginia pine have been collected. Non-normal yield tables for loblolly pine pulpwood were completed in final form and much of the preliminary computation for non-normal yield tables for the other two species has also been completed. A new form of yield equation was developed and found to simplify the work necessary for the preparation of these yield tables for all three species.

No satisfactory quick method has been devised for determination of growth in the all-aged stands of many species typical of the mountain types. It has been apparent for some time that development of accurate growth predicting techniques for such stands must be based on careful long-time observations of permanent sample plots. Nearly 3,000 such plots were established in 1933 and 1934.

Accomplishments during the past year: Remeasurement of about half the 3,000 growth plots was completed by the end of the year. Preliminary computations for part of these have been completed.

Plans for next year: Remeasurement of the plots is to be completed before growth begins in the spring. Plans for comparing results of prevalent methods of growth prediction with the reliable standard available from their remeasurement and for devising a more economical and efficient method of prediction will be completed and work started under them. Investigations of the optimum diameter distributions for all-aged stands will be started.

Date of completion: First results on growth and mortality of all-aged stands of mixed species in mountain types will be completed in 1941. Complete results of first phase should be ready for publication during 1942.

Assignment: J. H. Buell.

January 1, 1941

PROJECT STATUS SHEET

Tree Studies

Field division: Forest management research.

Work project: Mensuration.

Line project: Tree studies.

Purpose: To develop: (1) accurate methods for determining the volume of individual standing trees; (2) factors for converting wood volume from one unit of measure to another; and (3) a tree classification for important timber species.

Review of past work: Cubic-foot and cordwood volume tables and cordwood converting factors for second-growth loblolly pine have been completed.

Board-foot volume tables for important timber species in mountain hardwoods were prepared in 1936 and used by private foresters and in management plan and acquisition surveys in some southern Appalachian forests. Volume tables showing the amount of cordwood that can be removed from the tops of various species of oak above sawlog utilization have been prepared. Factors for the conversion of oak cordwood into solid cubic feet, units of stacked wood, and board-feet have been completed.

Exploratory studies in tree classification of loblolly pine and white oak have been conducted. It was found that, although a classification for determining the gross increment of individual trees could be made, the ultimate criterion of net value increment could not yet be determined because of inability to forecast the growth of decay and the lumber grade yields of trees of different sizes.

To improve accuracy of the volume tables made in 1936 and make them more applicable to small areas, work was begun on volume tables for Appalachian species based on form as well as d.b.h. and height, and on a study of the relation of form to locality, and of the possibilities of combining species in form class volume tables.

Accomplishments during the past year: A manuscript on stacked unit - cubic foot converting factors for oak topwood and crooked bolewood, and for straight oak bolewood, and on board foot - stacked unit converting factors for oak bolewood was accepted for publication. Computations on form class volume tables for 16 Appalachian species were completed. The equation originally used for oak top volume was found to result in too high an aggregate deviation. Computations on the basis of new equations have been started.

Plans for next year: Publication of form class volume tables and recommendations for their application. Publication of oak top volume tables.

Date of completion: Project as a whole is continuous. See plans for next year for completion of current work.

Assignment: J. H. Buell.

January 1, 1941

PROJECT STATUS SHEET

Statistical Studies

Field division: Forest management research.

Work project: Mensuration.

Line project: Statistical studies.

Purpose: To develop new techniques and methods of expressing the laws of forest growth and measurement.

Review of past work: This project as a whole is inactive and is used primarily as a means to provide an outlet for discoveries made during the conduct of other work.

Accomplishments during the past year: New Abney level correction tables, providing for expanded use of this instrument, were published. A first draft of a manuscript on the preparation of circular slide rules to solve linear equations was prepared. A manuscript describing a test for curvilinearity in multiple regression equations was revised.

Plans for next year: Publication of manuscripts on circular slide rules and on the test for curvilinearity in multiple regressions.

Date of completion: Project as a whole is continuous. New procedures and techniques in statistical methods will be published as they are developed in connection with other work.

Assignment: J. H. Buell.

January 1, 1941

PROJECT STATUS SHEET

Fire Control

Field division: Forest management research.

Work project: Forest fire protection.

Line project: Fire control.

Purpose: To develop methods for determining economic fire control objectives; to determine standards of detection and speed of strength and attack, based upon different degrees of occurrence, visibility, fuel type, inflammability, and potential damage; to develop instruments and techniques for increasing detection efficiency.

Review of past work: Major emphasis has been placed on detection planning and visibility studies. Accomplishments include the development of (1) techniques for seen area mapping and lookout-point value compilations, and (2) a haze meter for non-mountainous country. A three-year field study of variations in visibility distance has been completed, and theoretical considerations of visibility problems have been worked out. Manuscripts have been published on a plains haze meter and visibility variations. Some work has been done on a comprehensive study of the theory and application of visibility and its measurement. A contribution toward a regional fuel type classification was made by report analysis.

Accomplishments during past year: A study on an eyetest for lookouts has been completed and the results published. Over 300 eyetests were obtained by the Forest Service for use on the national forests. A filter was developed which cuts through haze and may be of considerable importance in increasing the visual range of small smokes.

Plans for next year: The manuscript "Theories of visibility and their application in forest fire detection" will be completed for Departmental publication. Complete manuscript on haze for the Monthly Weather Review and the paper on visual perception of small objects, which was an outgrowth of the eyetest studies. Analyze fire reports for the past 3 years for the purpose of revising fuel type classification and determining rate of spread of fires and resistance to control by danger classes and fuel types. Prepare results for release in a technical note. Complete tests on the "haze cutter" and prepare working plan for a study to determine its possibilities for practical application in increasing the visual range of forest lookouts.

Date of completion: Manuscripts on haze and visibility studies - 1941.
Preliminary results on rate of spread and resistance to control - 1941.

Assignment: G. M. Jemison, G. M. Byram, J. J. Keetch.

January 1, 1941

PROJECT STATUS SHEET

Fire Behavior

Field division: Forest management research.

Work project: Forest fire protection.

Line project: Fire behavior.

Purpose: (1) To determine the fundamental laws of ignition and combustion and their application to forest fires and (2) to develop methods of measuring the temporary or fluctuating fire danger variables and of integrating them into numerical ratings so that (a) fire control officers may be able to determine when different types of prevention, detection, and suppression activities are justified, (b) fire prevention and control efficiency may be rated correctly, and (c) fire control may be financed on a sound basis.

Review of past work: Fire danger meters have been developed for mountain and coastal plain regions and have been tested on an extensive scale. Results of an analysis of danger station records were used to check and improve meters and aid in fire control planning. Studies of fire weather conditions at 6 altitude and aspect stations have been under way for 3 years. A technical note on the danger rating system was issued, and manuscripts on the Appalachian fuel moisture scales and on the effect of sun and wind on fuel moisture were published. Some theoretical work has been done on fundamentals of combustion with particular reference to rating relative inflammability of different fuel types and crown fire danger.

Accomplishments during past year: Theoretical work on the fundamental relationship between fire behavior, relative inflammability, wind velocity and fuel type was continued. Studies of solar radiation effects on fuel moisture were completed and the manuscript containing the results is nearly completed. Field and laboratory work to determine the effects of terrestrial radiation on fuel moisture was completed. Check of mountain type and coastal type danger meters was continued. Fire danger ratings for both meters were compared with fire occurrence using both national forest and state organization records. Completed one year of actual field test in 2 states to devise effective adaptation of fire danger measurement system to state fire control organization; results are encouraging.

Plans for next year: Complete and submit for publication the following papers: (1) Solar radiation and forest fire danger, (2) Terrestrial radiation and forest fuel moisture, and (3) Possible causes of large crown fires in coniferous forests. Routine checks of mountain and coastal plains meters will be continued. The study of fire danger rating as influenced by altitude and aspect at danger station location will be continued. Records obtained to

(Over)

date from this study will be analyzed to determine whether results are conclusive enough to justify publication and closing out of the study. Basic work on combustion and inflammability as related to rate of spread will be continued. Continue studies on adaptation of fire danger system to state fire control organizations.

Date of completion: Check of fire danger meters and extension of their use - indefinite. Influence of altitude and aspect on fire danger ratings - 1942. Solar radiation and forest fire danger, terrestrial radiation and forest fuel moisture, possible cause of large crown fires in coniferous forests - 1941. Combustion and inflammability - indefinite.

Assignment: G. M. Jemison, G. M. Byram, J. J. Keetch.

January 1, 1941

PROJECT STATUS SHEET

Fire Effects

Field division: Forest management research.

Work project: Forest fire protection.

Line project: Fire effects.

Purpose: To ascertain the effect of fire on standing timber, reproduction, other vegetation, and site, in order to furnish information basic to (a) the formulation of sound fire prevention and control plans and policies, (b) the appraisal of fire damage, both tangible and intangible, and (c) the determination of the value of fire as a tool in forest or game management.

Review of past work: Past work has included (1) extensive surveys of tree mortality, and mortality and physical damage to vegetation on experimentally burned sample plots, (2) the prediction of cull following basal wounding, and (3) the development of a theory for appraisal of tangible damage.

Accomplishments during past year: Reexamination of sample plots brought mortality and growth figures up to date. A method for evaluating the effect of basal wounding on growth of several hardwood species was developed; the field work and a preliminary analysis of the data under this method were completed. Additional data were obtained on recent burns for the fire damage appraisal study. Past studies of tree mortality and cull prediction, work of last year on effects of fire on diameter growth and examinations of recent burns have been combined to furnish the basis for a fire damage appraisal table which has been completed. Effects of basal wounding on diameter growth were not found to contribute much to the total tangible effects of fire. This relationship was found to be obscure and additional material was obtained for a fundamental study of the effects of basal wounding on trees.

Plans for next year: The fire damage appraisal table, completed this year, will be released in a technical note containing directions for its use. Results of the fundamental study on effects of basal wounding on trees will be published. Routine examination of permanent experiments of fire effects will be continued.

Date of completion: Effect of fire on diameter growth of hardwoods - 1941.
Effect of annual controlled burning on growth and mortality of pine on coastal plain - indefinite. Results of damage appraisal study - 1941.

Assignment: G. M. Jemison, J. J. Keetch.

January 1, 1941

PROJECT STATUS SHEET

Relation of Forest Cover to Streamflow

Field division: Forest influences research.

Work project: Influence of natural vegetation on streamflow.

Line project: Relation of forest cover to streamflow.

Purpose: To determine the effects of forestry practices and forest land management upon the yield and quality of stream water.

Forest land management in the Southern Appalachian region in the broad sense, includes cutting systems for the removal of wood products, woodland grazing, fire protection, planting, mountain farming, and denudation by smelter fumes. These land-use practices will be studied.

Review of past work: Comprehensive research on the effects of land use on water conservation was begun in 1934. In all, 40 drainages have been observed for periods of 2 - 6 years. Records have been analyzed currently and special problems basic to drainage area research have been studied.

Accomplishments during past year: Proof that a number of drainage areas are sufficiently well standardized to proceed with changing the vegetative cover has been established.

Cover changes on 3 drainages were begun on the Coweeta Experimental Forest:

- (1) A study of unregulated grazing of forest land.
- (2) A study of mountain agricultural practices.
- (3) A study of temporary removal of forest and shrub cover.

Plans for next year: Three additional studies will be inaugurated:

- (1) A study of permanent removal of forest and shrub cover.
- (2) A study of cutting practices similar to national forest timber sales.
- (3) A study of commercial cutting practices.

A 5-year progress report of the project will be assembled. A technical paper will be prepared on land use effects on water for the Bent Creek Experimental Forest. The principal phases of watershed standardization methods will be treated technically for publication.

Date of completion: Continuous.

Assignment: C. R. Hursh, P. W. Fletcher, M. D. Hoover, J. M. Rosa.

January 1, 1941

PROJECT STATUS SHEET

Local Effect of Forests on Climate

Field division: Forest influences research.

Work project: Effect of cover on climate.

Line project: Local effect of forests on climate.

Purpose: To determine the influence of forest vegetation upon the meteorological conditions of its immediate environment.

Review of past work: Meteorological records that have been obtained in the course of 6 years of watershed studies on the Coweeta and Bent Creek Experimental Forests and in the Copper Basin have furnished basic data for analysis of vegetation effects on climate.

Special studies of local climates were conducted within the major vegetative zones of the Copper Basin for the period of 1934-1940. Sufficient data were obtained during this period to prepare a manuscript report on the project. All stations used in the above study with the exception of station #3 in the denuded zone were temporarily discontinued July 1, 1940. Station #3 is being maintained under a cooperative agreement with the Hydrological Data Section of the Tennessee Valley Authority.

Accomplishments during past year: Current meteorological records were taken as a part of all drainage area studies.

A manuscript has been prepared covering the results of 5 years' studies within the Copper Basin.

Plans for next year: The Copper Basin manuscript will be prepared for a board of review.

Other than analysis of data from meteorological station #3 under the present cooperative agreement with the Tennessee Valley Authority, no further work will be conducted in the Copper Basin area.

An office study will be made of past data collected by the Station relating seasonal temperature to water yield, evaporation and transpiration. On the basis of this study plans will be drawn up for supplementing present temperature records for the Coweeta Experimental Forest if necessary.

Date of completion: Continuous.

Assignment: C. R. Hursh, M. D. Hoover.

January 1, 1941

PROJECT STATUS SHEET

Transpiration and Other Consumptive Uses of Water by
Forest Cover

Field division: Forest influences research.

Work project: Water utilization by vegetation.

Line project: Transpiration and other consumptive uses of water by forest cover.

Purpose: To determine the effect of forest cover as related to canopy interception of rainfall, to transpiration, and to other consumptive use forms of water. This project also embraces a study of the effects of trees upon soil moisture and ground water.

Review of past work: A study of the interception of precipitation by tree canopies has been completed for 4 representative forest types in the 40-inch rainfall zone on the Bent Creek Experimental Forest. A report on this study has been in manuscript form for the past year. A second study of canopy interception was begun in the 70-inch rainfall zone on the Coweeta Experimental Forest in 1938.

Accomplishments during past year: Methods for determining transpiration from seasonal stream depletion curves and from diurnal fluctuation in streams and wells are being investigated as to their usefulness.

The measurement of the height of the water table in experimental wells has been carried on as a step in the analysis of the seasonal changes in the water storage factor for individual drainage areas; this is valuable in the analysis of consumptive uses of water. Analysis of records during the past year indicate that well records, when supplemented with current soil moisture determinations, may be used as an index of water storage opportunities. They will serve as a check on other methods of determining monthly storage and depletion.

Plans for next year: Expedite the review of the original canopy interception report for publication. Field records will be continued on the Coweeta Experimental Forest.

The transpiration study will remain an orientation study of methods for another year. The possibilities for expanding ground water studies will be investigated further.

Date of completion: Continuous.

Assignment: M. D. Hoover, P. W. Fletcher.

January 1, 1941

PROJECT STATUS SHEET

Roadbank Stabilization

Field division: Forest influences research.

Work project: Stabilization of soil.

Line project: Roadbank stabilization.

Purpose: To determine practical methods of permanently stabilizing roadbanks.

Review of past work: Beginning in 1934, the Station has conducted a series of studies covering the practical aspects of roadbank stabilization. Basic principles of vegetation establishment have been determined and demonstration areas of successful roadbank control are now available in every section of the Station's territory.

Accomplishments during past year: The Station was called upon to serve in advisory and personnel training capacity for numerous cases of roadbank control by state highway departments, national forests, and private citizens.

During the past year a reexamination was made of all experimental plots established since the inauguration of the project. Photographs were taken of representative results of different treatments. A manuscript on roadbank naturalization was prepared for review.

Special tests of the value of calcium metaphosphate, produced by the Tennessee Valley Authority, as a fertilizer for treated roadbanks were carried out on both the Coweeta and the Bent Creek Experimental Forests.

Plans for next year: Examination of all fertilized plots will be made in early spring and midsummer of 1941.

A general report on all roadbank studies made by the Station since 1934 will be assembled and summarized.

Date of completion: 1941.

Assignment: C. R. Hursh.

January 1, 1941

PROJECT STATUS SHEET

Problem Analysis

Field division: Range research.

Work project: Research program.

Line project: Problem analysis.

Purpose: To obtain through surveys basic material for preparation of project analysis and working plans for intensive studies of forest grazing and beef cattle production problems in the Coastal Plain area of North Carolina and Georgia.

Review of past work: Studies started in November 1940.

Accomplishments during past year: Since the memoranda of understanding were signed in late October in North Carolina and near the middle of December in Georgia, little time has been available for field work. A survey of forest grazing and beef cattle production problems in North Carolina is about one-third complete. The examinations being made are bringing out many things, some of which are: (1) management practices being followed and the results obtained vary widely, (2) many farmers are entering the cattle business, and the cattle industry is now growing rapidly, (3) farmers going into the cattle business are faced with many problems and need information and help, (4) a majority of the farmers are using forest areas to some extent in their cattle production program, and (5) timber reproduction and forest growth in this area are apparently favored by cattle grazing.

Plans for next year: Complete the survey of forest grazing and beef cattle production problems in North Carolina, and make a similar survey in Georgia. Compile and analyze data collected on the surveys and prepare a problem analysis for each state. Following this, working plans will be developed for intensive studies.

Date of completion: During calendar year 1941.

Assignment: H. H. Biswell (for grazing and forestry problems), Foster and _____ (BAI) (for cattle production problems).

January 1, 1941

PROJECT STATUS SHEET

Utilization Standards

Field division: Range research.

Work project: Grazing management.

Line project: Utilization standards.

Purpose: To determine acre requirement at different seasons of the year, and proper degree of utilization.

Review of past work: Studies started in November 1940.

Accomplishments during past year: Rates of stocking calculated and estimates of degree of utilization made for three pastures grazed last summer at the Wenona Station in North Carolina. A pasture of 73 acres was very closely utilized and severely overgrazed; one of 32 acres was closely utilized and moderately overgrazed; and one of 80 acres was moderately utilized and appeared to be about properly grazed. Figured on a yearly basis so as to compare rates of stocking, 3.2 acres per cow were provided in the 73-acre pasture, 4.2 acres in the 32-acre pasture, and 5.7 acres in the 80-acre pasture. If the 80-acre pasture was about properly stocked, as estimated, then the 73-acre pasture was 80 percent overstocked and the 32-acre pasture was 36 percent overstocked.

A 96-acre pasture has been fenced at the Wenona Station in North Carolina and stocked for the purpose of determining acre requirements for fall grazing.

Observations made thus far of grazing intensity in Georgia show that 8 acres of woodland pasture, along with a small area of permanent pasture, results in moderate use of the woodland pasture. No damage to trees was observed and the fire hazard was estimated to be reduced about 50 percent through grazing.

Plans for next year: Calculate rates of stocking for the last 4 years in the 73, 32, and 80-acre pastures at the Wenona Station in North Carolina. Compare these rates of stocking with weights of animals to determine if there is any correlation. In the 96-acre pasture determine acre requirement for fall grazing and measure degree of utilization.

In Georgia, make measurements of degree of utilization in typical pastures in the Coastal Plain area. Calculate acres required for proper grazing.

Date of completion: Project as a whole is continuous. Type of studies may vary pending preparation of the work problem analysis.

Assignment: H. H. Biswell, R. W. Slocum, _____.

January 1, 1941

PROJECT STATUS SHEET

Values

Field division: Range research.

Work project: Range plants

Line project: Values.

Purpose: To determine the make-up of the animal diet at different seasons of the year, and the nutritional qualities of the different forage plants -- results to be correlated with animal conditions.

Review of past work: Studies started in November 1940.

Accomplishments during past year: Estimates of species composition of cattle diet made bi-weekly at the Wenona Station in North Carolina since the animals were put in the 96-acre fall pasture. Studies revealed that the reed, Arundanaria tecta, composed 98 percent or more of the diet each time. Groundsel-tree, Baccharis halimifolia, because of its scarcity in the pasture, made up only a trace of the diet each time, but it was rated as being the most palatable plant in the pasture at this season. Wool-grass, Scirpus cyperinus, made up only a trace of the diet and its palatability was rated very low.

Samples of most commonly grazed plants were collected bi-weekly and sent to laboratory for chemical analysis.

Plans for next year: Follow cattle at bi-weekly periods at Wenona Station in North Carolina and at two out-post stations in different forage types to determine composition of animal diet. Collect samples of commonly grazed plants each period for chemical analysis.

Select two or three representative forest types in Georgia where cattle will be followed periodically in order to determine composition of their diet and to collect samples of commonly grazed plants for chemical analysis.

Date of completion: Project as a whole is continuous -- detailed studies subject to modification pending development of work project analysis.

Assignment: H. H. Biswell, R. W. Slocum, _____.

January 1, 1941

PROJECT STATUS SHEET

Forest Survey -- Inventory Phase

Field division: Forest economics.

Work project: Survey of forest resources.

Line project: Inventory.

Purpose: To determine the extent, location, and condition of forest lands in the Station's territory and the quantity, kinds, quality, and availability of timber now standing on these lands.

Review of past work: The Forest Survey organization was established at this Station in April 1936. Field work was begun in July of that year but was discontinued for the period from December 1937 to June 1938. By November 1939, when the field organization was again disbanded, all of South Carolina not previously covered by the Southern Station and all of North Carolina had been completed; a total of 45 million acres. There remained nearly 65 million acres in Virginia, West Virginia, Tennessee, and Kentucky to be completed.

Basic tables of area and volume were completed for all units in North and South Carolina and state tables were prepared for South Carolina.

Accomplishments during past year: Inventory field work was started in Virginia the latter part of February. After a week of intensive field training, six 3-man field crews were organized and started on lines in the Coastal Plain unit. A seventh crew was added in May. A field office was established in Richmond to facilitate supervision of the crew work. When the Coastal Plain unit was completed the work was extended to the Piedmont Region and later to the Mountain Region in the western part of the state. The line plot work for the entire state was completed in the middle of December. Approximately 4,000 miles of line were run during the year and over 32,000 sample plots were recorded.

As lines were completed in Virginia the plot sheets were forwarded to the Southern Station with instructions for punching and tabulating on the Hollerith machines. By the end of the year cards had been punched for units 1 and 2 and tabulating was under-way for these units.

Volume tables for the Coastal Plain and Piedmont units, based on Girard's field work, were completed during the year.

Consolidated tables of area and volume were compiled for North Carolina for use in the state report.

Plans for next year: No inventory field work is planned for 1941, except the collection of data for volume tables for the mountain units in Virginia. Basic tables of area and volume will be completed for all Virginia units during 1941.

Date of completion: Indefinite.

Assignment: G. E. Morrill, T. C. Evans, John Carow.

January 1, 1941

PROJECT STATUS SHEET

Forest Survey -- Growth and Yield Phase

Field division: Forest economics.

Work project: Survey of forest resources.

Line project: Growth and yield.

Purpose: To determine the current and probable future rate of timber growth and the productive capacity of the forest area.

Review of past work: Growth computations for the year of inventory were completed for South Carolina and all but the mountain unit of North Carolina. Growth data for South Carolina were summarized for use in the state report.

Accomplishments during the year: Growth computations were completed for the mountain unit of North Carolina, and the growth data for both North Carolina and South Carolina were carried forward through 1938.

The Survey staff critically reviewed the growth procedure used in previous work and made plans for revising the procedure in the Virginia units.

Plans for next year: Details of plans for revising the growth procedure in Virginia will be worked out and computations will be made for at least the Coastal Plain and Piedmont units.

The growth data for North and South Carolina will be carried forward through 1939.

Date of completion: Continuous.

Assignment: G. E. Morrill, T. C. Evans, E. V. Roberts, J. W. Cruikshank.

January 1, 1941

PROJECT STATUS SHEET

Forest Survey -- Drain Phase

Field division: Forest economics.

Work project: Survey of forest resources.

Line project: Drain.

Purpose: To determine the rate at which the forest is being diminished through industrial and domestic use.

Review of past work: A mill-to-mill canvass of primary forest industries was completed in South Carolina in 1937 and in North Carolina in 1938. Through a cooperative agreement with the Bureau of Census, the Survey sent the Census the complete lists of sawmills in North and South Carolina and checked and edited the Census questionnaires on 1938 lumber production in North Carolina and made a field check of mills not answering the questionnaire.

A field check of the non-lumber wood-using industries in South Carolina was also made during 1939. The sawmill drain for these years was obtained from census records supplemented by visits to a number of the larger mills.

Accomplishments during the past year: The cooperative agreement with the Bureau of the Census was extended to cover 1939 lumber production in both North Carolina and South Carolina. Census enumerators for the biennial census visited the mills and forwarded the forms to this Station for checking and editing. Considerable question has been raised regarding the completeness of the census coverage as only 2,250 mills were reported for the two states compared to a total of 3,800 mills reported operating in 1938. Field checks by the Survey of two counties in North Carolina also indicated that a number of mills had been missed by the census enumerators. No Survey funds were available for a complete check of delinquent mills so that adjustment of the 1939 production will be made, based on previous reports supplemented by such information as can be obtained in the 1940 Census of lumber production.

During the year drain figures for both North Carolina and South Carolina were carried forward through 1938.

Plans for next year: A complete mill-to-mill canvass of primary wood-using industries in Virginia will be made by the Survey to obtain 1940 production. The field men will make out census forms at the same time so that a complete and accurate census report for this state will be obtained.

(Over)

January 1, 1941

RE - 49
FOREST SURVEY
Data

The Census will mail questionnaires to all sawmills in North and South Carolina. These will be forwarded to this Station for checking and editing. Survey field men will make a field canvass in these states of mills not replying to the questionnaire, and at the same time will obtain information regarding mills unreported for 1939.

Drain records for North and South Carolina will be brought up to date and the Virginia drain data will be computed for 1940.

Date of completion: Continuous.

Assignment: G. E. Morrill, T. C. Evans, John Carow.

Review of past work: A preliminary survey of primary forest resources was completed in South Carolina in 1937 and in North Carolina in 1938. Through a cooperative agreement with the Bureau of Census, the Survey sent the Census the complete lists of sawmills in North and South Carolina and checked and edited the Census questionnaires on 1938 lumber production in North Carolina and made a field check of mills not answering the questionnaire. A field check of the non-lumber wood-using industries in South Carolina was also made during 1939. The sawmill drain for these years was obtained from census reports supplemented by visits to a number of the larger mills. Accomplishments during the past year: The cooperative agreement with the Bureau of the Census was extended to cover 1939 lumber production in both North Carolina and South Carolina. Census enumerators for the detailed census visited the mills and forwarded the forms to this Station for checking and editing. Considerable attention has been placed regarding the completeness of the census coverage as only 3,250 mills were reported for the two states compared to a total of 3,500 mills reported operating in 1938. Field checks by the Survey of two counties in North Carolina also indicated that a number of mills had been missed by the census enumerators. No Survey funds were available for a complete check of delinquent mills so that adjustment of the 1939 production will be made based on previous reports supplemented by such information as can be obtained in the 1940 Census of Lumber production. During the year drain figures for both North Carolina and South Carolina were carried forward through 1938. Plans for next year: A complete mill-to-mill canvass of primary wood-using industries in Virginia will be made by the Survey to obtain 1940 production. The field men will make out census forms at the same time as that a complete and accurate census report for this state will be obtained.

(Over)

January 1, 1941

PROJECT STATUS SHEET

Forest Survey -- Report Phase

Field division: Forest economics.

Work project: Survey of forest resources.

Line project: Reports.

Purpose: Analysis and interpretation of data and preparation of reports.

Review of past work: Reports for the three Survey units in South Carolina were published and the first draft of the South Carolina State report was completed.

Compilation of field data was completed for the Piedmont and Coastal Plain units of North Carolina and the report for North Carolina Unit #1 was submitted for review.

Accomplishments during past year: Analysis of the data for the North Carolina units was completed and reports were published for the three eastern units under the following titles:

Forest Survey Release No. 4 - Forest Resources of the Southern Coastal Plain of North Carolina.

Forest Survey Release No. 5 - Forest Resources of the Northern Coastal Plain of North Carolina.

Forest Survey Release No. 6 - Forest Resources of the Piedmont Region of North Carolina.

The report for the Mountain Region of North Carolina (Survey Unit #4) was submitted for review.

Following review of the first draft of the South Carolina State report, revision of several chapters was found advisable. This revision is approximately 50 percent completed. Completion of this report was delayed by the transfer of W. T. Hicks to the Bureau of Agricultural Economics.

Compilation of data for the North Carolina State report was begun and a preliminary statement regarding Survey findings in the state was prepared for the Christmas number of the Southern Lumberman.

Plans for next year: Completion of the state reports for both North and South Carolina and of at least one unit report for Virginia are planned for 1941.

Date of completion: Indefinite.

Assignment: J. W. Cruikshank, John Carow, E. V. Roberts.

January 1, 1941

PROJECT STATUS SHEETPreliminary Flood Control Examinations

Field division: Forest influences research.

Work project: Flood control surveys.

Line project: Preliminary flood control examinations.

Purpose: Examination of watersheds to determine existence of flood problems, the feasibility of flood control by the Department of Agriculture, and to locate the critical silt and flood source areas.

Review of past work: During 1937 the Station cooperated in preparing the preliminary report for the Pee Dee watershed. In 1938, under Station chairmanship, a preliminary report was completed for the Potomac watershed. In 1939, under Station chairmanship, a preliminary report was completed for the section of New River above the proposed Bluestone Flood Control Reservoir. During 1939 the Station also cooperated in the preparation of a preliminary report for the Santee-Cooper watershed.

Accomplishments during past year: Under Station chairmanship preliminary reports on the Big Sandy, Little Kanawha, and Roanoke watersheds were completed. The Station also assisted in the preparation of a preliminary report on the Neuse River watershed.

Plans for next year: Assist in completion of Neuse preliminary report.

Date of completion: Except for a small amount of work on the Neuse River report all work will be completed by February 1, 1941, unless additional examinations are assigned.

Assignment: H. C. Woster, L. M. Shames.

January 1, 1941

PROJECT STATUS SHEET

Survey Work Outlines and Advance Studies

Field division: Forest influences research.

Work project: Flood control surveys.

Line project: Survey work outlines and advance studies.

Purpose: Survey work outlines are general outlines of the objectives, scope, procedures, time, personnel, and money needed to complete a flood control survey. Advance studies are designed to obtain additional information and justification for or against a survey when the evidence contained in the preliminary report is inconclusive or where unusual events such as current floods require immediate work to obtain current flood information.

Review of past work: In 1939, under Station chairmanship, the survey work outline for the Potomac survey was completed. In 1939 the Station also assisted in preparing a survey work outline for the Pee Dee survey.

Accomplishments during past year: A survey work outline was prepared in rough draft for the New River watershed. This was not completed, but in its place was prepared a recommendation for advance study on this watershed. During the year advance study was done on numerous watersheds affected by floods produced by the August 11-17 and 29-30 storms.

Plans for next year: Tentatively the preparation of a survey work outline for the Roanoke watershed is planned. If undertaken this work will probably be started after completion of the Potomac Survey on April 1. Completion of advance study of August 1940 floods.

Date of completion: Tentative Roanoke survey work outline, probably by July 1, 1941.

Assignment: Present Potomac survey personnel.

January 1, 1941

PROJECT STATUS SHEET

Watershed Surveys

Field division: Forest influences research.

Work project: Flood control surveys.

Line project: Watershed surveys.

Purpose: Detailed field surveys of approved watersheds to determine the conservation or minor engineering measures needed to retard runoff and control soil erosion for flood control, to determine a plan for putting these measures into effect and to determine their economic feasibility.

Review of past work: In 1938 and 1939 the Station cooperated in a survey of the Coosa River watershed above Rome, Georgia. This survey was started September 1938 and completed September 1939. In October 1939 a survey, under Station chairmanship, was started on the Potomac River watershed, above Washington, D. C. In October 1939 a survey, with Station cooperation, was started on the Pee Dee watershed.

Accomplishment during past year: Both the Potomac and Pee Dee Surveys were continued through the past year. No new surveys were undertaken during 1940. A revision of the Coosa Survey Report will probably be started in December 1940.

Plans for next year: The Potomac Survey will be continued into 1941. It is probable that the Pee Dee Survey will also be continued into 1941 after the interruption caused by the revision of the Coosa Survey Report. A revision of the Coosa Survey Report will probably consume about 3 months time during the first of the year. Plans for starting new surveys during 1941 are indefinite.

Date of completion: Potomac Survey, April 1, 1941; Pee Dee Survey, indefinite. Coosa Survey Revision, probably about April 1, 1941.

Assignment: H. J. Loughhead, A. L. Richey, Thomas Lotti, M. M. Bryan, J. P. Clawson, Earl Myers, R. D. Williams, O. K. Krogfoss, F. W. Cater, Marie Turnipseed, J. E. Keefus, William Grady.